

# **SOUTH FORK JOHN DAY RIVER HABITAT ENHANCEMENT PROJECT**

## **ANNUAL REPORTS 1986 & 1987 and FINAL REPORT**

Prepared by:

Ron Wiley, Fisheries Biologist  
Bureau of Land Management  
Bums, OR

Prepared for:

U.S. Department of Energy  
Bonneville Power Administration  
Division of Fish and Wildlife  
P.O. Box 3621  
Portland, OR 97283-362 1

Project Number 85-71  
Contract Number DE-AI79-85BP25385

MAY 1993

---

# **SOUTH FORK JOHN DAY RIVER HABITAT ENHANCEMENT PROJECT**

ANNUAL REPORT 1986

Prepared by:

Ron Wiley, Fisheries Biologist  
Bureau of Land Management  
Burns, OR

Prepared for:

U.S. Department of Energy  
Bonneville Power Administration  
Division of Fish and Wildlife  
P.O. Box 3621  
Portland, OR 97283-3621

Project Number 85-71  
Contract Number DE-AI79435BP25385

MAY 1993

---

TITLE: Project 85-71 - South Fork John Day River Habitat Enhancement Project  
Evaluation

ANNUAL REPORT, 1986 - Monitoring Phase

AGREEMENT NO.: DE-AI79-85BP25385

PROJECT PERIOD: September 1, 1985 to March 31, 1991

EXECUTIVE SUMMARY: A study to monitor physical effects of the South Fork John Day River Habitat Enhancement Project was set up and read during August, 1986.

ABSTRACT : Between August 11 and 14, 1986, a study to monitor physical effects of the South Fork John Day River Habitat Enhancement Project was established and read for the first year of the five year monitoring period. A total of five reaches were selected as representative of the fourteen reaches to be treated in the project. Each sample reach was one hundred yards in length. Parameters measured were stream discharge, water velocity, bottom profile, depth, width, thalweg, pool:riffle ratio, substrate composition, streambank erosion, riparian cover, and instream cover. A single color photo was taken at each of the three transects established in each sample reach. Each sample reach was sketched showing instream cover, riparian cover and eroding streambanks. These data will be retaken each year for four years to determine physical changes in the treated reaches.

## INTRODUCTION

During September 1986, 1,500 boulder were placed in 14 reaches of the South Fork John Day River (SFJDR) approximately between RM 14 and RM 25. Each boulder was 3 feet or greater in at least one dimension. The boulders were placed in a variety of configurations (i.e., V's, diamonds, double V's, jetty-like groups, lines perpendicular to the flow, as well as random distribution in existing pools), each determined as best fitted to specific site features (i.e., depth, flow, velocity, bank condition, existing or potential riparian cover, substrate, channel morphology and existing instream objects).

The purpose of the project was to increase rearing area for summer steelhead smolts by providing increased instream cover in stream reaches deficient in such cover. Table 1 provides details on pre-project rearing area. For the purposes of this discussion and report, rearing area and instream cover are equivalent. During field measurements instream cover was defined as stream area that functioned as rearing area.

The role of the SFJDR in rearing juvenile steelhead, particularly from age 1+ to smolt, is vital to the system as a whole. Many, if not all, of the tributaries produce juveniles in numbers exceeding the stream's capacity to rear to smolt. These fish migrate to the SFJDR and are reared to smolt there. It is estimated that the project reach rears approximately 1,400 summer steelhead presmolts per mile.

An increase in rearing cover (i.e., pools, boulder, undercut banks, etc.) can be expected to produce an increase in the number of juvenile summer steelhead reared to smolt. When fully developed and stabilized, it is estimated that rearing area for an additional 7,500 smolts will be provided with this project. Previous electroshocking studies (BLM, unpublished data), of earlier boulder placements in the SFJDR revealed that an average of 5 rainbow-steelhead smolts use each boulder. This is expected to hold true for this project as well. A habitat evaluation study carried out by ODF&W in 1983 (Lindsay, 1983) on Deer Creek, a tributary of the SFJDR, showed a 119 percent increase in age 1 and older rainbow-steelhead 1-year after boulder placement. If the assumption is used that this will hold true in the SFJDR, it could be expected that an additional 5,000 age 1 and older rainbow-steelhead will use the treated reaches the first year post-project. With full pool development, this figure would rise over the next 3 to 5 years. Therefore, it would appear that the 7,500 smolts expected, due to increased rearing area provided by the project, is conservative.

In order to document the effectiveness of the project in accomplishing planned objectives, a 5-year monitoring study was set up. The goal of this study is to quantitatively measure physical changes in treated stream reaches.

---

## OBJECTIVES

The objectives of this study are as follows:

1. Monitor and document changes in bottom profile, depth, width, flow (volume and velocity), thalweg, pool/riffle ratio, substrate composition, streambank erosion, riparian cover, and cover as a result of boulder treatment.
2. Evaluate the effectiveness of boulder treatment as a fish habitat improvement technique.

## METHODS

### Station Selection and Layout

Five reaches were selected as permanent monitoring stations (Plate A). Selection criteria included: 1) streambank access and 2) representativeness of the station to the total project area in relation to parameters measured. Characteristics of stream reaches treated varied through the project area. For this reason stations were selected to portray this variation rather than for homogeneity.

Each station is 100 yards in length as measured along the mid-channel line. A permanent marker was placed at the head of each station to both mark the station and to serve as head stakes for bottom profile measurements. Additionally, nearby trees were marked with paint to facilitate station relocation. A total of three transects were established, one at the head, one in the center, and one at the end of each station. Each end of each transect was marked with a permanent marker.

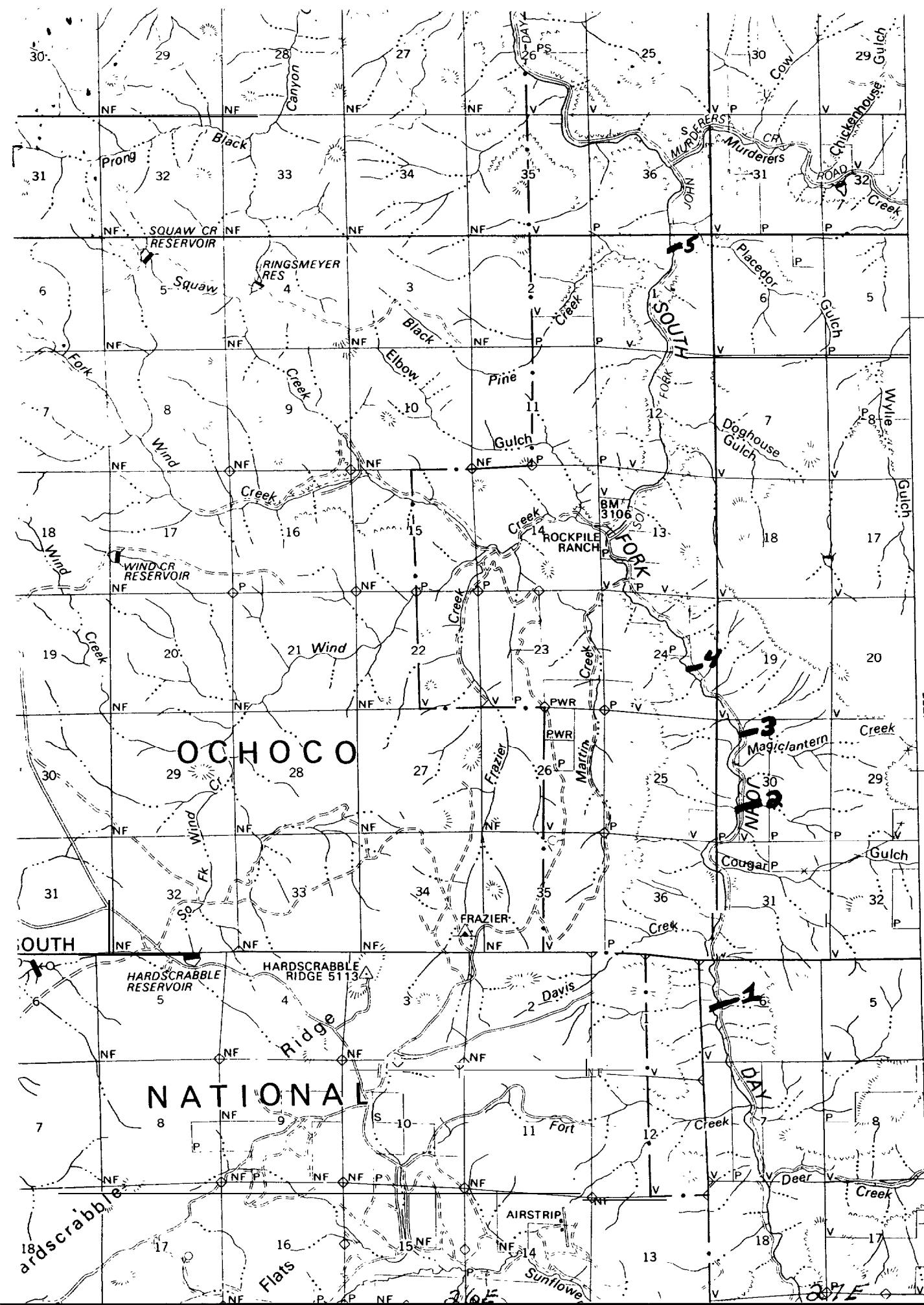
### Parameters Measured and Methods Used

Bottom Profile. Bottom profile was measured along the thalweg and across each transect with an automatic level and level rod using standard surveying techniques. A depth reading was taken at each point where there was a change in bottom profile, substrate or a major object (i.e., boulder or debris). In the latter case a reading was taken on the object and immediately to either side of it. A water surface elevation was taken in conjunction with each bottom profile reading.

Width. Width was measured at 10-yard intervals beginning at the head of the station and ending at the bottom of the station (i.e., 11 measurements in 100-yard station).

Depth. Depth was calculated from water surface elevation and bottom profile data.

Stream Discharge/Water Velocity. Flow data was taken at each point along the transects and thalweg where depth was read.



T. 15 S.

IZEE

Substrate Composition. Substrate composition was recorded from the bottom profile and percentages of mud (silt), debris, gravel, cobble and boulders estimated over the entire station length.

Instream Cover. **Instream** cover was measured for the entire station length. Each separate component was measured individually and mapped to facilitate future comparisons.

Pool/Riffle Ratio. The pool/riffle ratio was calculated from data gathered while mapping **instream** cover.

Streambank Erosion. Streambank erosion was measured along both sides for a total length of eroded bank in the station.

Rioarian Cover. A measurement was taken of the total length of streambank with riparian cover from a point five feet above the high water mark to waters edge. A percentage of the water area covered was estimated.

## RESULTS/CONCLUSIONS

**Instream** cover ranged from 2.5 to 7.6 percent of the total surface area with an overall average of 4.5 percent for all five study reaches combined (Table 1). This is approximately one-third of the minimum of 15 percent considered adequate for juveniles (Raleigh, 1984).

Thalweg lengths ranged from 98.7 to 112.3 percent of the stream midline length with an average of 104.2 percent for all reaches combined (Table 1). This indicates a relatively uniform stream channel devoid of irregularities which divert the current. These same irregularities either provide or act with the current to create **instream** cover. Average thalweg depths ranged from .51 to 1.49 feet with an average for all reaches of 1.05 feet (Table 1). This is less than the about 1.2 feet that is considered to be desirable (Raleigh, 1984). Thalweg depths within the desired range varied from 1.6 percent of the total thalweg length in Reach 2 to 72.4 percent in Reach 3 with an average for all reaches combined of 30.8 percent (Figures 1-5). Thalweg velocities ranged from .65 to 1.45 fps with a combined average of 1.06 fps. Again, this is outside the desired range of about 1.0 to 3.0 fps (**Binns**, 1982). Thalweg velocities within the desired range varied from 14.2 percent of the total thalweg length in Reach 5 to 60.1 percent in Reach 2 with an average for all reaches combined of 35.92 percent (Figures 1-5). However, the two sets of figures discussed above somewhat overstate the portion of the thalweg with suitable depths and velocities. When thalweg depth and velocities in Figures 1-5 are examined as overlays of each other, it becomes apparent that suitable depths often do not coincide with suitable velocities. Analysis of the overlay between suitable thalweg depths and velocities shows a range from 0 percent in Reach 1 to 16.0 percent in Reach 3 with a combined average for all reaches of only 7.8 percent.

Average water velocities across each transect ranged from 0.16 to 1.04 fps (Table 1). Individual measurements ranged from 0 to 3.4 fps. Only about 4.4 percent of the total area within the transects was within the .8 to 1.6 cfs velocity range suitable for juveniles. Depths across the transects ranged from 0 to 1.82 feet. Only about 0.9 percent of the area within the transects was within the depth range suitable for juveniles (1.5 to 2.5 feet) (Raleigh, 1984). None of the area had both suitable depth and velocity for juveniles.

Optimum pool area is considered to be between 40 to 60 percent of the total surface area (Raleigh, 1984). When only pools of first or second class were considered, pool area in the sample reaches ranged from a low of 2 percent in Reach 2 to a high of 29 percent in Reach 3 (Table 1). The remainder of the pool area had one or more attributes of poor quality pools for rearing, such as silt bottoms, inadequate depth, unsuitable water velocities, lack of cover (i.e., rubble, wood debris, etc.) or unacceptable visibility (i.e., lack of turbulence).

Substrates in all sample reaches were composed primarily of fines and cobble (4 to 10 inch diameter). Fines were most prevalent in pools and cobbles in riffles. Where both were found in pools, fines commonly filled the interices in the cobble. The percent composition of the substrate represented by fines ranged from a low of 15 percent in Reach 1 to a high of 49 percent in Reach 4 with a combined average of 34 percent (Table 1). **Instream** cover is most important to juveniles as opposed to shoreline cover for adult trout. Therefore, the lack of this cover in the form of clean cobble and boulder is limiting to rearing area.

Riparian cover was limited in all the sample reaches ranging from 2 percent of the water surface area in Reaches 3, 4 and 5 to 5 percent in Reaches 1 and 2 (Table 1). Linear distance of streambank (both sides) occupied by woody riparian vegetation varied from only 8 percent in Reach 4 to 57 percent in Reach 1 (Table 1). In all reaches the majority of this vegetation was young. In a 1985 study (Li, et.al, **1985**), found that rainbow/steelhead trout numbers were positively correlated to the quality and amount of riparian vegetation. Therefore, the observed deficiency in quality and quantity of woody riparian vegetation can be expected to be limiting to the reaches' potential for rearing. However, with continued proper livestock management, both the linear distance occupied with woody species and the percentage of the water surface shaded will increase.

A related parameter, eroding bank, is presently generally poor in most stream reaches. The percent eroding bank ranged from 0 percent of the total streambank (both sides) in Reach 5 to 50 percent in Reach 4 (Table 1). In a healthy system unstable streambanks are limited to 10 to 20 percent of the total bank length (Bowers, et.al., 1979). Reach 4 was unique in that one bank is stable along its entire length while the other bank is actively eroding along its entire length. The eroding bank is a 4 to 6 foot high vertical **cutbank**. This **cutbank** is both contributing to the sediment load of the river and inhibiting reestablishment of woody riparian vegetation. This last situation is caused by the current impinging directly on the streambank.

Another related parameter is water temperature. The lack of shading is resulting in abnormally high water temperatures. Measured water temperatures ranged from 23.0 • C (73.4 • F) in Reach 5 to 26 • C (78.8 • F) in Reach 1 (Table 1). Temperatures progressively increased throughout the day with the highest temperatures measured in late afternoon (**4:30** p.m.). Therefore, the 23.0 • C reading taken at **1:30** p.m., was at least 2 to 3 • C below the maximum reached. Optimal temperatures are considered to be between 12 to 15 ■ C (53.6 to 59 • F), however, water temperature as high as 26 • C can be withstood by these desert adapted fish if considerable diurnal fluctuation occurs (Bowers, et.al, 1979). As can be seen, observed maximum water temperatures were at the upper tolerance levels. Better shading and increased pool area and depth can mitigate these temperatures.

---



## SUMMARY

Pre-project data has been collected. Analysis of this data was limited because it is baseline. This limited analysis showed what would be expected in light of the fact the treatment reaches were chosen because of their lack of good habitat.

Sample reaches typically were wide, shallow, slow-moving and poor in quality **instream** cover. Thalweg lengths ranged from 98.7 percent to 112.3 percent of the stream midline length. Substrates were dominated by mud and cobble with most spawning size gravel silt covered. Water temperatures were at levels which could be considered limiting. All reaches were deficient in quality pool area.

Reaches 1, 3 and 4 had near or greater than **50:50** pool:riffle ratios. However, in Reach 3 both pool and riffle types were limited with pool area comprising only about 29 percent of the total surface area. In Reaches 1 and 4 about 74 percent of the total pool area was poor quality. Reach 5 had no riffle area at all, and only 12 percent of the total surface area comprise quality pool area. **Instream** cover in all five reaches ranged from 3.4 to 7.3 percent of the total surface area.

When examining the data on riparian cover an apparent discrepancy involving linear and percent water surface area covered is seen. The reason for this is two-fold. First, the width of these reaches decreases the shading ability of existing riparian vegetation. Second, little of this existing vegetation is mature which reduces its shading value.

In general, all sample reaches were deficient in rearing area. All components necessary for quality rearing area, such as **instream** cover, first and second class pools, clean cobble and gravel for food production and escape cover, suitable combinations of water depth and velocity and suitable water temperatures were either severely limited or outside optimum ranges.

The next four years of this study will focus on changes in the parameters measured. Some of these, such as thalweg, water velocities and percent cover, will be the direct result of the boulder placement completed in 1986. Others such as riparian cover, eroding bank, average width, substrate, surface area and temperature will result from a combination of the **instream** treatment and other management activities. A good example of the latter is riparian cover and eroding bank. Some of the 1,500 boulders placed were planned to provide bank protection. If they are successful the eroding streambanks will stabilize and allow the establishment of riparian vegetation. However, proper livestock management is also critical to the successful establishment and growth of this vegetation. Therefore, this study will seek to evaluate not only habitat change brought about by the enhancement project, but also that which can be gained by improved management in conjunction with habitat enhancement.

---

## LITERATURE CITED

- Lindsay, Robert. 1983. John Day River Habitat Enhancement Evaluation - Annual Report, 1983. Annual report to Bonneville Power Administration. Project Number 82-9. **In:** Natural Propagation and Habitat Improvement Volume I - Oregon Final and Annual Reports, **1982/1983**. Bonneville Power Administration, P.O. Box 3621, Portland, Oregon 97208.
- Raleigh, R.F., T. Hickman, R.C. Solomon and P.C. Nelson. 1984. Habitat Suitability Information, Rainbow Trout. USDI Fish and Wildlife Service. **FWS/OBS-84/10.6**. 66 pp.
- Binns, N. Allen. 1982. Habitat Quality Index Procedures Manual. Wyoming Game and Fish Department, Cheyenne, Wyoming. pp. 209.
- Li, H.W., E.J. Lestzinher and R.A. Tubb. 1985. A Hierarchical analysis of Habitat Quality for Anadromous Juvenile Salmonids in Subbasins of the John Day Drainage. An unpublished final report submitted to USDI Geological Survey. **Reston**, Virginia 22092.
- Bowers, W., B. Hosford, A. Oakley and C. Bond. 1979. Wildlife Habitats in Managed Rangelands - The Great Basin of Southeastern Oregon, Native Trout. USDA Forest Service - USDI Bureau of Land Management Gen. Tech. Rep. PNW-84, 16 pp.
-

Table 1: Physical Habitat Measurements

	Length (ft)	Avg. Width (ft)	Surface Area (ft)	Thalweg		Water Velocity (fps)				Substrate (%)				
				Length (ft)	Avg. Depth (ft)	Transect			Thalweg	Silt	Sand	Gravel	Cobble	Boulder
						12	3							
Reach No. 1	300	26.0	8,469	337	.51	1.04	.16	.72	1.19	15	0	<1	84	<1
Reach No. 2	300	32.7	10,401	316	.73	.31	.66	.30	1.13	25	<1	<1	73	2
Reach No. 3	300	24.5	7,347	297	1.13	.84	.28	.88	1.45	40	<1	<1	59	1
Reach No. 4	300	24.2	7,386	296	1.49	.63	.32	.23	.88	49	<1	<1	49	2
Reach No. 5	300	54.7	16,838	317	1.38	.46	.32	.28	.65	40	<1	10	50	<1

	Pool: Riffle Ratio	Cover		Riparian Cover		Eroding Bank(ft)	Temperature (-C)	Discharge (cfs)
		Area	%	Linear (ft)	Water Area Covered			
Reach No. 1	<b>64:36</b> <u>1/</u>	643	7.3	342	5	143	26.0	7.4
Reach No. 2	<b>3:97</b> <u>2/</u>	256	2.5	207	5	199	24.5	9.3
Reach No. 3	<b>63:37</b> <u>3/</u>	417	5.7	297	2	51	25.0	10.6
Reach No. 4	<b>76:24</b> <u>4/</u>	417	5.6	50	2	300	25.0	10.2
Reach No. 5	<b>31:69</b> <u>5/</u>	578	3.4	99	2	0	23.0	11.6

1/ Total usable pool area is 26 percent of total pool area.

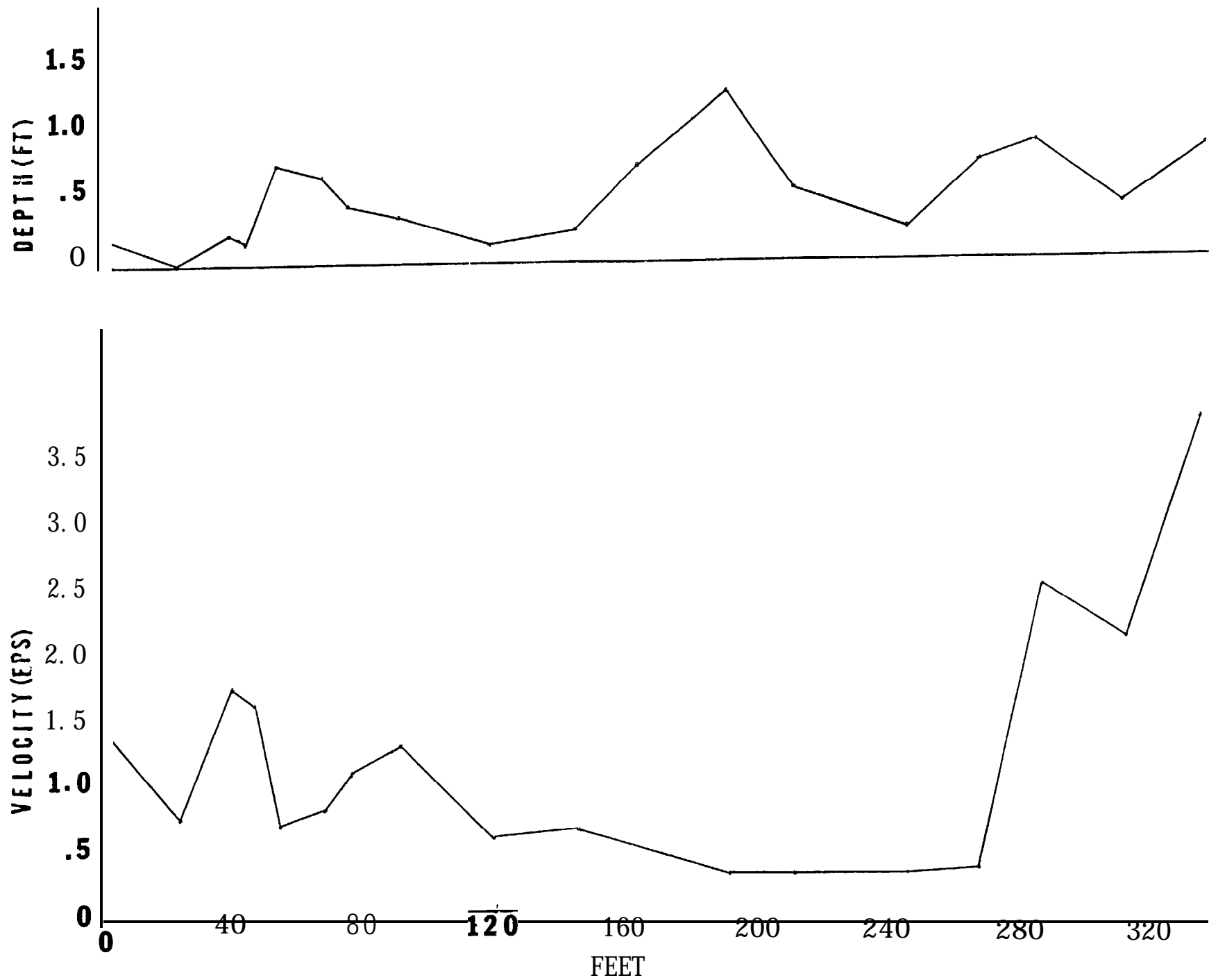
2/ Total usable pool area is 100 percent of total pool area.

3/ Total usable pool area is 44 percent of total pool area.

4/ Total usable pool area is 26 percent of total pool area.

5/ Only 12 percent of reach is pool. Total usable pool area is 7 percent of total pool area.

FIGURE 1: THALWEG DEPTHS & VELOCITIES - REACH NO.1



# **SOUTH FORK JOHN DAY RIVER HABITAT ENHANCEMENT PROJECT**

**ANNUAL REPORT -1987**

Prepared by:

Ron Wiley, Fisheries Biologist  
Bureau of Land Management  
Burns, OR

Prepared for:

U.S. Department of Energy  
Bonneville Power Administration  
Division of Fish and Wildlife  
P.O. Box 3621  
Portland, OR 97283-362 1

Project Number 85-71  
Contract Number DE-AI79435BP25385

MAY 1993

---

TITLE: Project 85-71 - South Fork John Day River Habitat Enhancement Project  
Evaluation

ANNUAL REPORT. 1987 - **Monitoring** Phase

AGREEMENT NO.: **DE-AI79-85BP25385**

PROJECT PERIOD: September 1, 1985 to March 31, 1991

EXECUTIVE SUMMARY: A study to monitor physical effects of the South Fork John Day River Habitat Enhancement Project was continued during September 1987.

ABSTRACT: Between September 21 and 23, 1987, a 5-year study established in 1986 to monitor physical effects of the South Fork John Day River Habitat Enhancement Project was continued. Stream discharge, water velocity, bottom profile, depth, width, thalweg, **pool:riffle** ratio, substrate composition, streambank erosion, riparian cover and **instream** cover were measured and compared to pre-project conditions measured in 1986. In general, quantity and quality of rearing area for summer steelhead improved. Almost all improvements were the result of the boulder placement project being monitored.

## METHODS

During the week of September 21, 1987, the five study reaches established in September 1986 were reread. Parameters measured during the pre-project phase (September 1986) were again measured using procedures established and refined in 1986. The South Fork John Day River Habitat Enhancement Project Monitoring Plan and the South Fork John Day River Habitat Enhancement Project Annual Report, 1986, Monitoring Phase - 1st Year (Pre-Project) should be referred to regarding details on parameters and procedures.

## RESULTS/CONCLUSIONS

**Instream** cover ranged from 9.1 to 11.5 percent of the total surface area. All five study reaches combined exhibited an overall average of 10.2 percent cover to total surface area. This is approximately 68 percent of the minimum of 15 percent considered to be adequate for juveniles (Raleigh, 1984). This represents an increase over 1986 conditions ranging from 58 percent in Reach 1 to 30 percent in Reach 2 with an overall increase of 122 percent for all study reaches combined (Figure 46). This increase was due, almost entirely, to boulders placed in the 1986 project. In addition to cover provided by scouring around the boulders, they also were providing cover in pools previously devoid of cover and, thus, increasing the area of the study reach suitable for rearing juveniles.

Thalweg lengths ranged from 99.3 to 126.3 percent of the stream mid-line length with an average of 108.9 for all reaches combined (Table 1). Thalweg lengths in three study reaches (2, 4 and 5) did not vary significantly with pre-project lengths. Reaches 1 and 3 increased by 12.5 and 8.1 percent, respectively.

Thalweg depths ranged from 0.13 to 3.0 feet with average depths of 0.7 to 1.71 feet (Table 1). The average thalweg depth for all reaches combined was 1.25 feet. This compares to ranges in thalweg depths of 0.01 to 2.73 feet, average thalweg depths of 0.5 to 1.49 feet and an overall average of 1.05 feet, as measured in 1986. Average thalweg depth in Reach 1 increased from 0.51 to 1.21 feet, an approximate 237 percent increase over pre-project conditions. Average thalweg depths in Reaches 2, 3 and 5 decreased by about 5 percent, although Reach 5 remained within optimum depth parameters ( $\geq 1.2$  feet). Reach 4 increased in average thalweg depth by about 87 percent, from 1.49 to 1.71 feet. In 1987, average thalweg depths fell within optimum parameters in three of five reaches as compared to two of five reaches in 1986, and declined below optimum in none. Thalweg depths equal to or greater to minimum optimum depth varied from 0 percent of the total thalweg length in Reach 2 to 93.3 percent in Reach 4 with a combined average for all reaches of 46.8 percent (Figures 36-40). This is an overall increase of 32.4 percent over pre-project conditions. Individual reaches varied from a 100 percent decrease in Reach 2, although this only represented a change from 1.6 percent to 0 percent to a 1036.8 percent increase in Reach 1, representing a change from 5.6 percent to 52.0 percent. Reaches 3 and 5 decreased in this parameter by 20.5 and 28.9 percent, respectively. As in the case of Reach 2, these decreases represented minimal changes of only 72.4 percent to 60.2 percent and 44.3 percent to 31.9 percent, respectively.

Thalweg velocities ranged from **.30** fps to **.78** fps with a combined average of **.54** fps (Table 1). Individual measurements varied from **.03** fps to 3.25 fps. This compares to average velocities of **.65** fps to 1.45 fps and individual measurements of **.1** fps to 3.75 fps in 1986. About 21.8 percent of the total thalweg was within the desired range of 1.0 to 3.0 fps (Binns, 1982). **This** compares to 35.9 percent in 1986, an about 39 percent decrease.

Thalweg profiles generally indicated little change or an actual increase in streambed elevation (Figures 6 to 10). This could be the combined result of changes in thalweg location due to deflection by placed boulders and lack of scouring flows due to below average low winter and spring flows. The winter of 1986-87 was particularly dry compared to average conditions and spring run-off reflected this. However, thalweg water depths did not reflect the change in thalweg profile. As noted above, average thalweg depths and percent of thalweg length at least 1.2 feet in depth actually increased over 1986. Additionally, this occurred with significantly lower flows at the time of measurement.

Average water velocities across each transect ranged from **.05** to **.50** fps (Table 1). Individual measurements varied from 0 to 1.175 fps. This compares to average velocities of 0.16 to 1.04 fps and individual measurements of 0 to 3.4 fps in 1986. About 6.1 percent of the total area along the transects was within the **.8** to 1.6 cfs velocity range suitable for juveniles. This compares to 4.4 percent in 1986, or an about 38 percent increase.

Depths across the transects ranged from 0 to 2.12 feet. About 6.0 percent of the area within the transects was within the 1.5 to 2.5 foot range suitable for juveniles (Figures 11-25). This compares to pre-project conditions of 0.9 percent, a 567 percent increase. Again, as with pre-project conditions, suitable depths and velocity did not coincide anywhere along the transects.

Pool area comprised of first and second class pools ranged from a low of 10 percent in Reach 2 to a high of 52 in Reach 4. Two study reaches (3 and 4) contained good quality pool area within the range considered to be optimum (40 to 60 percent). Reaches 1, 2 and 5 were 85, 65 and 67 percent of the lower limit, respectively (Figure 47). Percent change in this parameter between pre-project conditions and 1987 varied from 1,143 percent in Reach 2 to 50 percent in Reach 3, with a combined average of 158 percent.

Substrates in all sample reaches were composed primarily of fines and cobble (4 to 10 inch diameter). As in 1986, pools that had the highest concentration of silt and riffles were largely comprised of cobbles. The percent composition of the substrate represented by fines ranged from a low of 1 percent in Reach 2 to 45 percent in Reach 4. The combined average for all reaches was 23 percent (Table 1). When compared to pre-project conditions, there was more gravel available in all but one study reach (Reach **3**), which stayed the same. Reaches 2, 3, 4 and 5 had more cobble free of silt while Reach 1 had increased area silt covered. The percent of the substrate composed of boulders increased in all reaches. This was, of course, a direct result of the 1986 boulder placement project. Overall, **instream** cover for juveniles composed of clean cobble and boulders increased by 4 percent over pre-project conditions. This is even more notable when it is viewed in the light of the lack of flushing flows through the system in 1987, due to below normal streamflows. However, only the increased number of boulders can be attributed to the project.



Riparian cover remained limited in all reaches, however, an apparent positive trend continues. Only Reach 4 showed an increase (3 percent) over pre-project conditions (Table 1). Only Reach 4 showed a significant increase in linear distance. In this reach, linear streambank with woody riparian cover increased 120 percent from 50 to 110 feet. Much of this can be attributed to project work possibly assisted by low run-offs. In this reach, the entire west streambank was an actively eroding 4 to 6 foot high **cutbank**. Along this reach, boulders were placed in groups next to this **cutbank** in an attempt to protect the bank as well as provide **instream** cover. To date, both objectives are being met. The **cutbank** is healing and pools are forming around the boulders. Future years will tell if the bank will continue to stabilize in the face of higher flows, but the prospect appears good. In any event, the boulders will continue to provide needed cover. This technique appears to hold promise for bank stabilization when used in conjunction with proper livestock management where a "light touch" is desired and **instream** cover is needed.

A related parameter, eroding bank, showed improvement in all reaches. Reach 4 showed a 100 percent decrease in actively eroding streambank from 300 feet to 0 feet. The reasons for this are discussed in the above paragraph. The percent eroding bank ranged from 0 percent in Reaches 4 and 5 to 32 percent in Reach 2. Overall, the percent eroding bank declined by over one-half from 23 percent of the total bank length to 11 percent. Under pre-project condition, only Reaches 3 and 5 had under the 10 percent unstable streambank which characterizes a healthy system. In 1987, three study reaches (Reaches 3, 4 and 5) exhibited this characteristic.

Another parameter related to riparian cover and shading is water temperature. Measured water temperatures were lower than those measured in 1986. However, a one-time measurement is not sufficient to detect changes. Without significant differences in the percent of the water surface shaded a decrease in water temperatures due to other than ambient air temperatures would not be expected to have occurred. However, with deeper pools and more **instream** cover, as compared to pre-project conditions, there was more area with reduced water temperatures to mitigate high water temperatures throughout the remainder of the reach.

#### SUMMARY

Data collected in 1987 showed improvement in aquatic habitat conditions as related to juveniles. This improvement was limited by the lack of bed scouring due to the below normal streamflows experienced during the preceding year. Study reaches were still best typified as wide, shallow and slow moving.

Thalweg lengths had increased to a limited extent showing a trend towards a channel more diverse in structure. Stream bottom profiles showed little change and, in some cases, actually raised. Water depths, however, showed an increase suggesting that the lack of scouring flows coupled with a change in thalweg location due to project work had, to date, masked improvements. The percent of the thalweg and transect lengths within the suitable depth range increased from 36.2 percent to 46.8 percent and 0.9 percent to 6.0 percent, respectively.

---

Water velocities showed mixed change. The percent of the thalweg with velocities within the desired range decreased 39 percent from 35.9 percent to 21.8 percent. On the other hand, the percent of transect lengths with velocities within the desired range increased about 38 percent from 4.4 percent to 6.1 percent. The lower thalweg velocities can be explained by the about 62 percent decrease in flow over 1986. Why transect velocities did not also decrease is unexplained.

Pool:rifle ratios differed from pre-project conditions in only one reach. In Reach 2, the pool:rifle changed from **3:97** to **20:80**. More indicative of changes in pool habitat is the comparison of good quality pool area between 1986 and 1987.

Increases in good quality pool area varied from 66 percent in Reach 3 to 1,152 percent in Reach 2, for an overall average of 239 percent for all reaches combined. These increases were due to both actual increased pool area and effective increased pool area. The latter was the direct result of providing cover in pools devoid of cover. Both increases were the direct result of boulder placements. In 1986, none of the study reaches were within the range considered optimum for juveniles (40 to 60 percent total surface area in good quality pools), while in 1987 two reaches (3 and 4) fell within this range and Reaches 1, 2 and 5 were 85, 65 and 67 percent of low optimum, respectively.

Riparian cover remained limited in all reaches. However, an apparent positive trend continues. Reach 4 did show a significant increase (120 percent) in linear distance covered with woody riparian species. Riparian shading, as would be expected, only increased (3 percent) in Reach 4. A related parameter, eroding bank, improved in all study reaches. The most dramatic improvement occurred in Reach 4, where actively eroding streambank declined from 300 feet to 0 feet as a combined result of low flows and current deflection by placed boulders. The number of study reaches meeting the less than 10 percent unstable streambank criteria for healthy systems increased from 2 in 1986 to 3 in 1987, with another (Reach 1) below 20 percent unstable streambanks.

**Instream** cover increased significantly in all reaches. The greatest increases occurred in Reaches 2 and 5 with 304 and 168 percent change, respectively (Figure 46). These increases were due almost entirely to boulder placement.

In general, all study reaches exhibited significant increases in rearing area. Most components necessary for quality rearing area, such as **instream** cover, good quality pool area and clean cobble and gravel increased. Suitable combinations of water depth and velocity actually decreased, probably due to below normal streamflows. Water temperatures continued to be outside optimum ranges. However, if the present improving trend in riparian vegetation continues, these can also be expected to decline. The lack of scouring flows have significantly slowed expected changes. The fact that these changes are occurring to the degree discussed above, points to the value of this technique in increasing rearing area for salmonids, in this case, summer steelhead.

#### LITERATURE CITED

- Binns, N. Allen. 1982. Habitat Quality Index Procedures Manual. Wyoming Game and Fish Department, Cheyenne, Wyoming. pp. 209.
- Raleigh, R.F., T. Hickman, R.C. Solomon and P.C. Nelson. 1984. Habitat Suitability Information, Rainbow Trout. USDI Fish and Wildlife Service. **FWS/OBS-84/10.6**. 66 pp.

#### LITERATURE REVIEWED BUT NOT CITED

- Bowers, W., B. Hosford, A. Oakley and C. Bond. 1979. Wildlife Habitats in Managed Rangelands - The Great Basin of Southeastern Oregon, Native Trout. USDA Forest Service - USDI Bureau of Land Management Gen. Tech. Rep. PNW-84, 16 pp.
- Li, H.W., E.J. Lestzinger and R.A. Tubb. 1985. A Hierarchical analysis of Habitat Quality for Anadromous Juvenile Salmonids in Subbasins of the John Day Drainage. An unpublished final report submitted to USDI Geological Survey. **Reston**, Virginia 22092.
- Lindsay, Robert. 1983. John Day River Habitat Enhancement Evaluation - Annual Report, 1983. Annual report to Bonneville Power Administration. Project Number 82-9. **In:** Natural Propagation and Habitat Improvement Volume I - Oregon Final and Annual Reports, **1982/1983**. Bonneville Power Administration, P.O. Box 3621, Portland, Oregon 97208.
-

Table 1: Physical Habitat Measurements

			Length (ft)	Avg. Width (ft)	Surface Area (ft <sup>2</sup> )	Thalweg		Water Velocity (fps)				Substrate (%)				
						Length (ft)	Avg. Depth (ft)	Transect			Thalweg	Silt	Sand	Gravel	Cobble	Boulder
								1	2	3						
Reach	No. 1	300	29.6	11,605	379	1.21	.41	.04	.28	.77	40	<1	10	47	3	
Reach	No. 2	300	29.4	10,699	319	.70	.05	.15	.06	.78	1	1	5	89	5	
Reach	No. 3	300	22.8	8,137	321	1.07	.25	.11	.50	.30	16	<1	<1	80	4	
Reach	No. 4	300	32.7	10,934	298	1.71	.08	.03	.02	.30	45	<1	10	37	8	
Reach	No. 5	300	53.1	17,547	320	1.30	.25	.09	.50	.53	15	2	15	65	3	

Pool: Riffle		Cover		Riparian Cover		Eroding Bank(ft)	Temperature (.C)	Discharge (cfs)
Ratio		Area	%	Linear (ft)	Water Area Covered			
Reach	No. 1	64:36 <u>1</u> /	1,335	11.5	360	5	105	2.4
Reach	No. 2	20:80 <u>2</u> /	1,078	10.1	196	5	189	2.9
Reach	No. 3	63:37 <u>3</u> /	877	10.8	300	2	39	3.5
Reach	No. 4	76:24 <u>4</u> /	1,100	10.1	110	5	0	2.3
Reach	No. 5	31:69 <u>5</u> /	1,593	9.1	110	2	0	8.3

1/ Total usable pool area is 54 percent of total pool area.  
2/ Total usable pool area is 100 percent of total pool area.  
3/ Total usable pool area is 68 percent of total pool area.  
4/ Total usable pool area is 71 percent of total pool area.  
5/ Total usable pool area is 91 percent of total pool area.

FIGURE 1: STREAM PROFILE, REACH #1

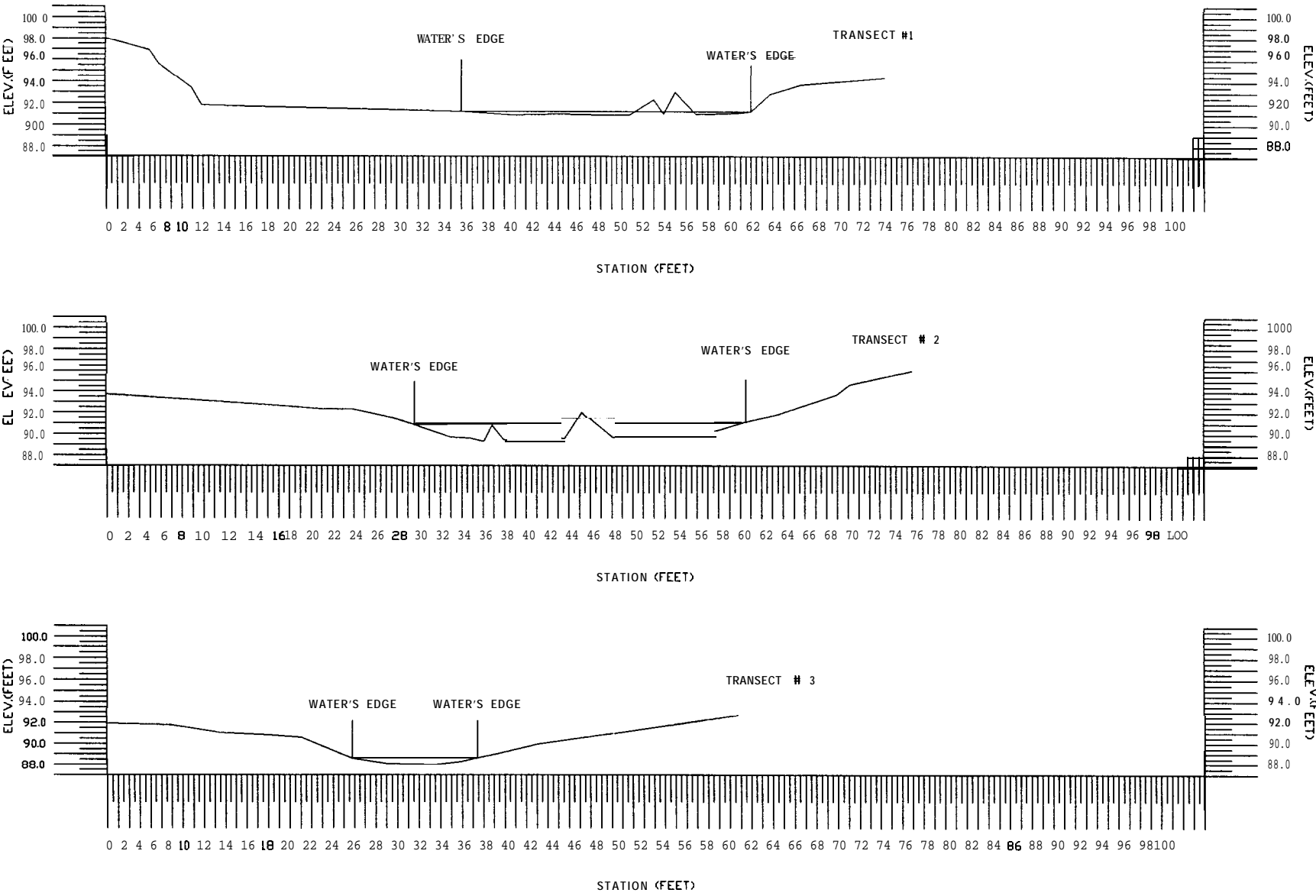


FIGURE 2: STREAM PROFILE, REACH #2

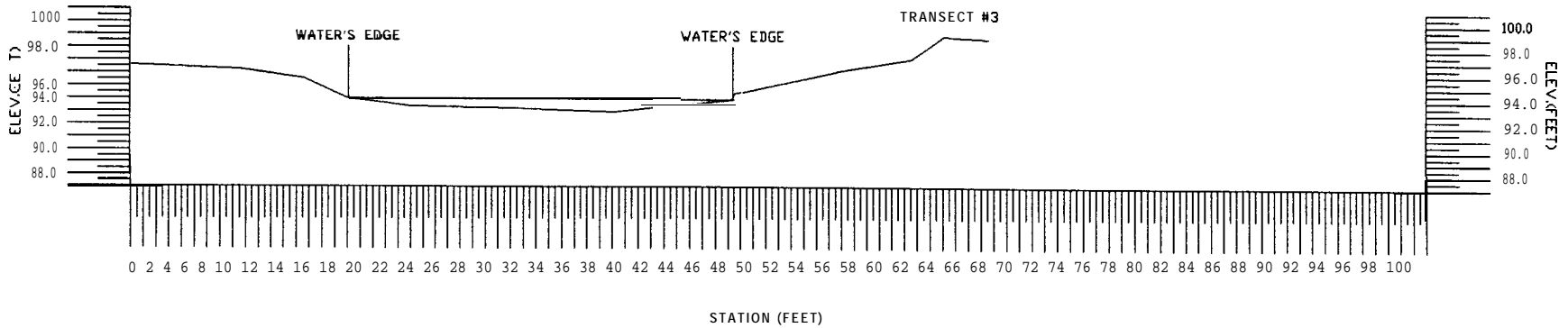
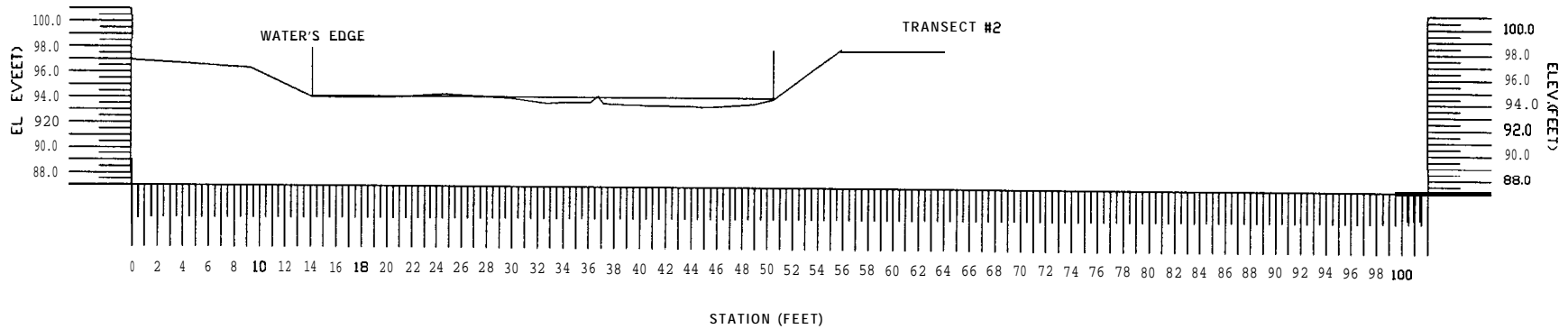
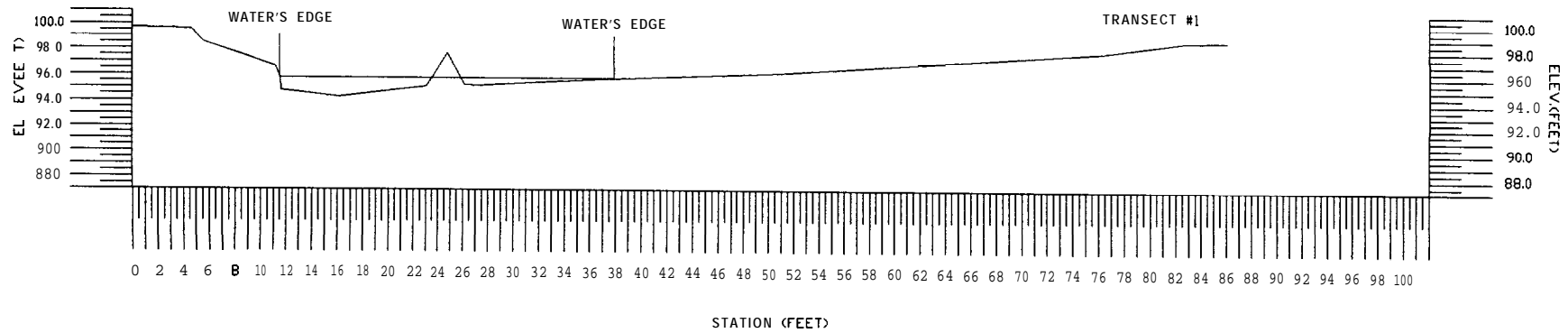


FIGURE 3: STREAM PROFILE, REACH #3

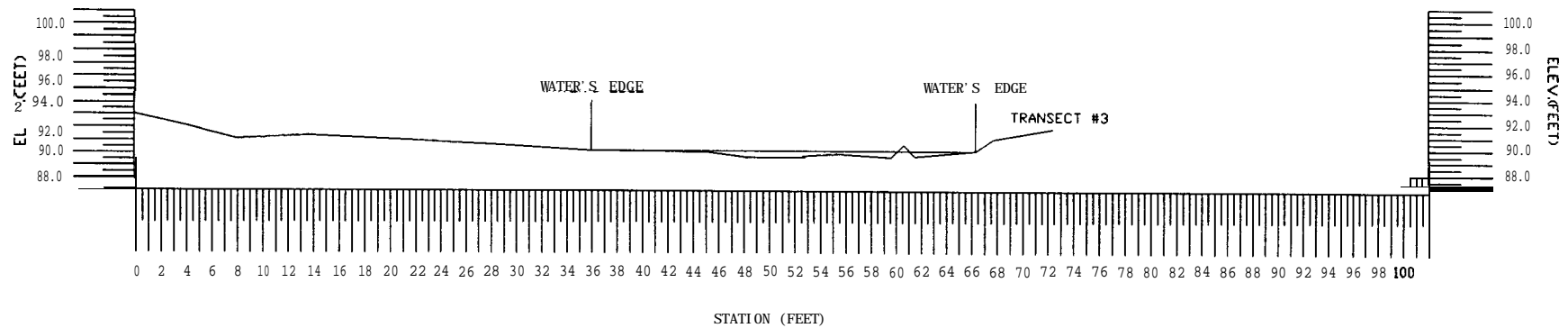
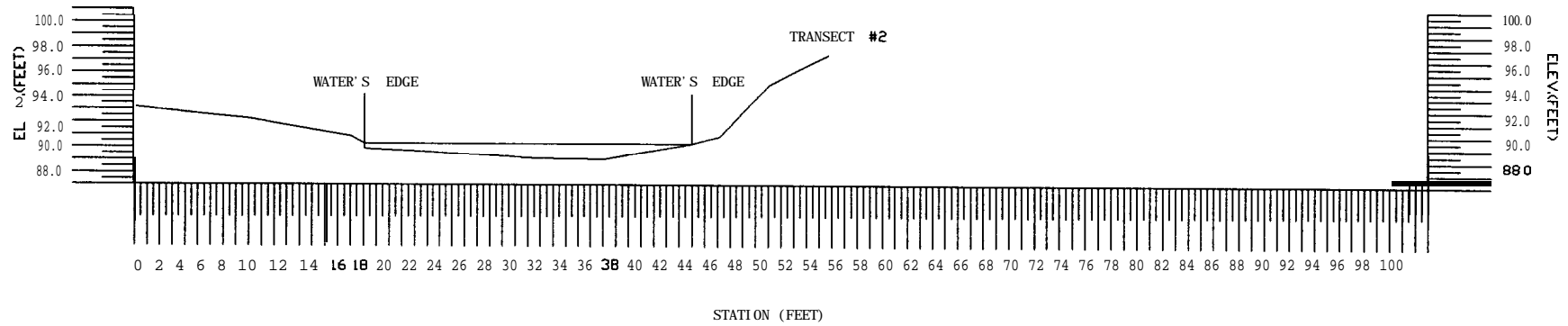
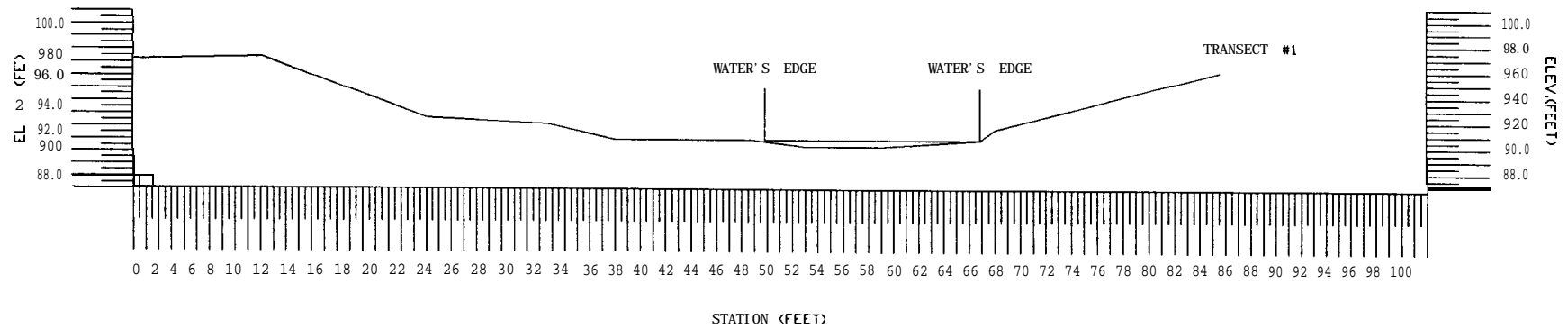


FIGURE 4: STREAM PROFILE, REACH #4

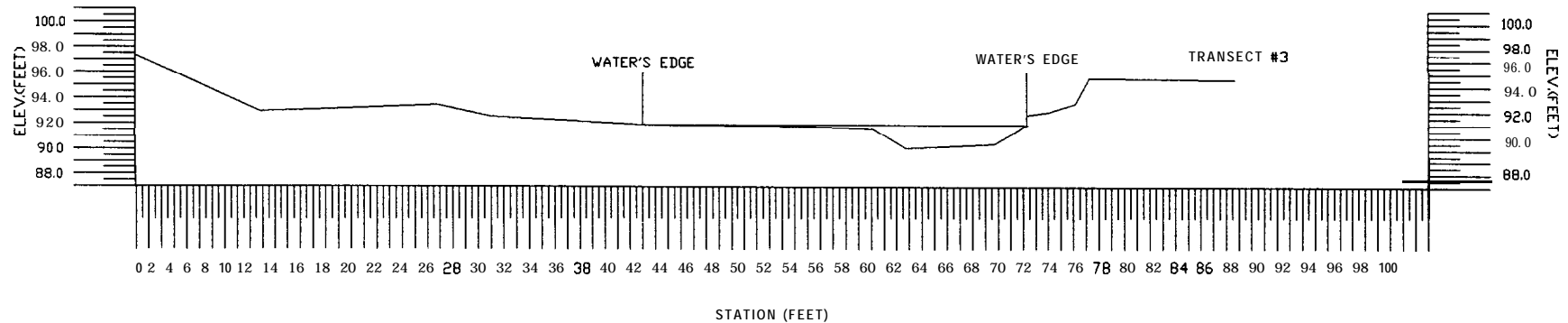
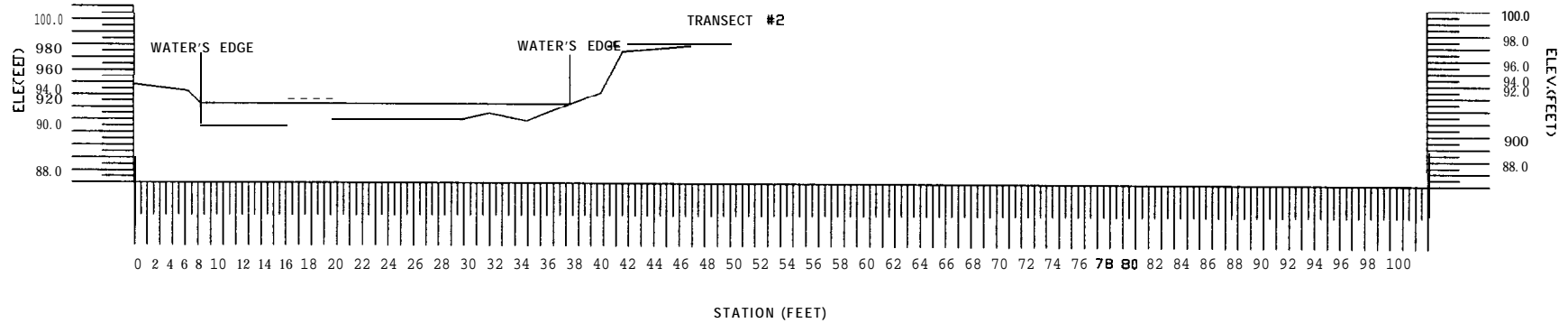
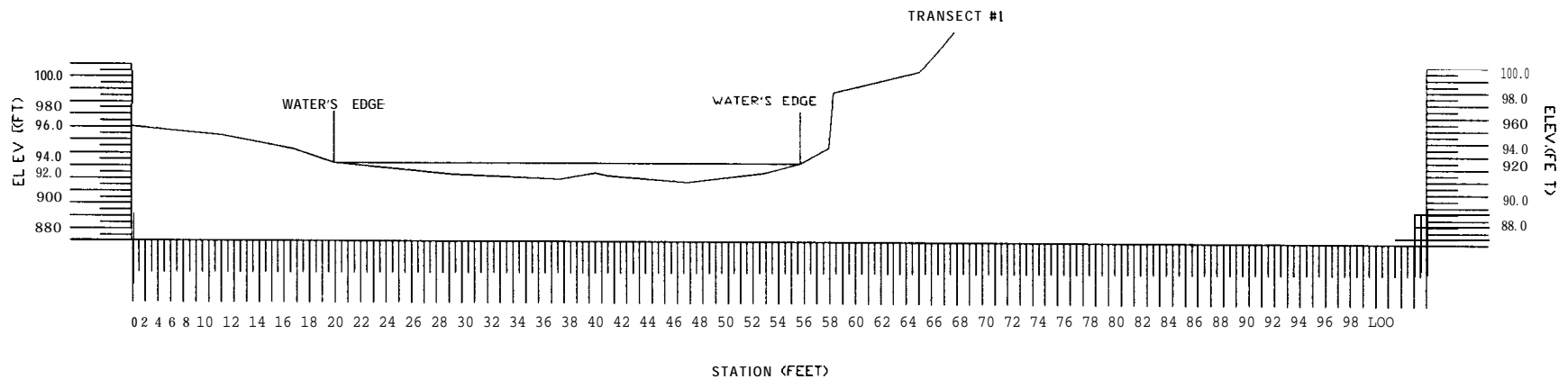




FIGURE 5: STREAM PROFILE, REACH #5

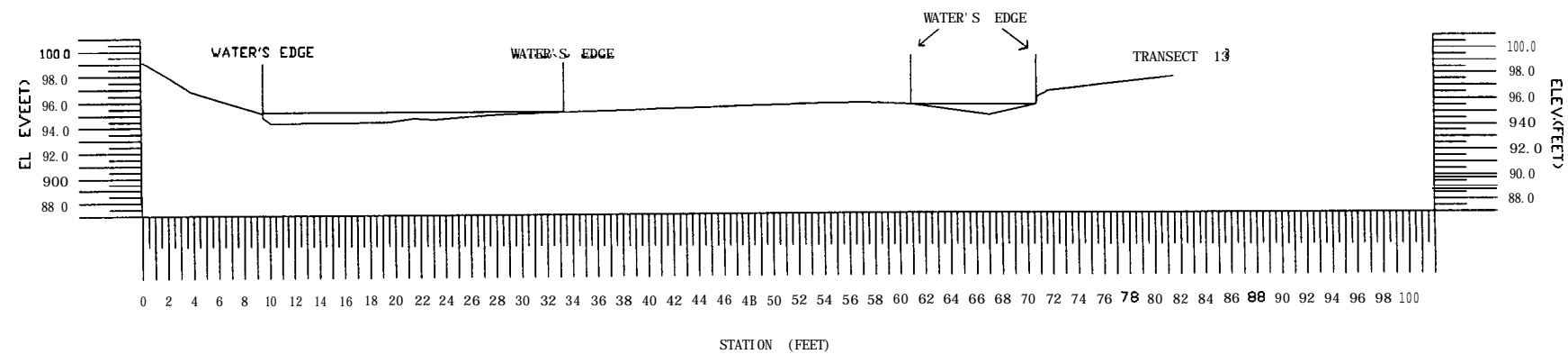
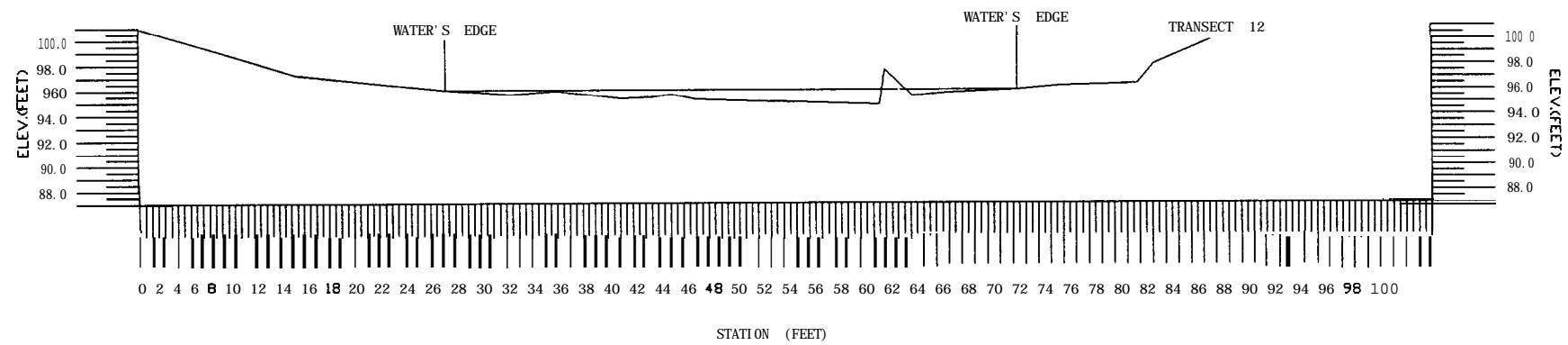
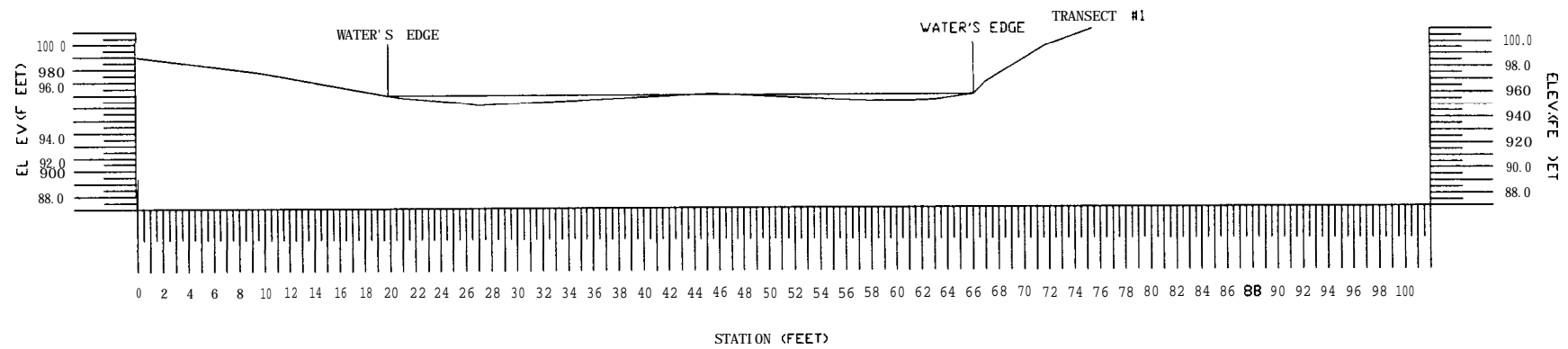


FIGURE 6: THALWEG BOTTOM PROFILE, REACH #1

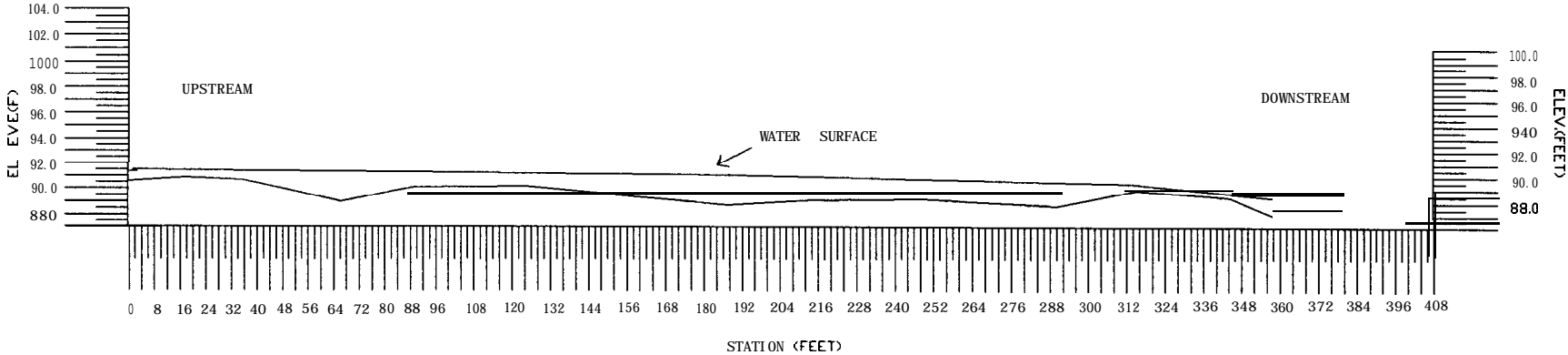


FIGURE 7: THALWEG BOTTOM PROFILE, REACH #2

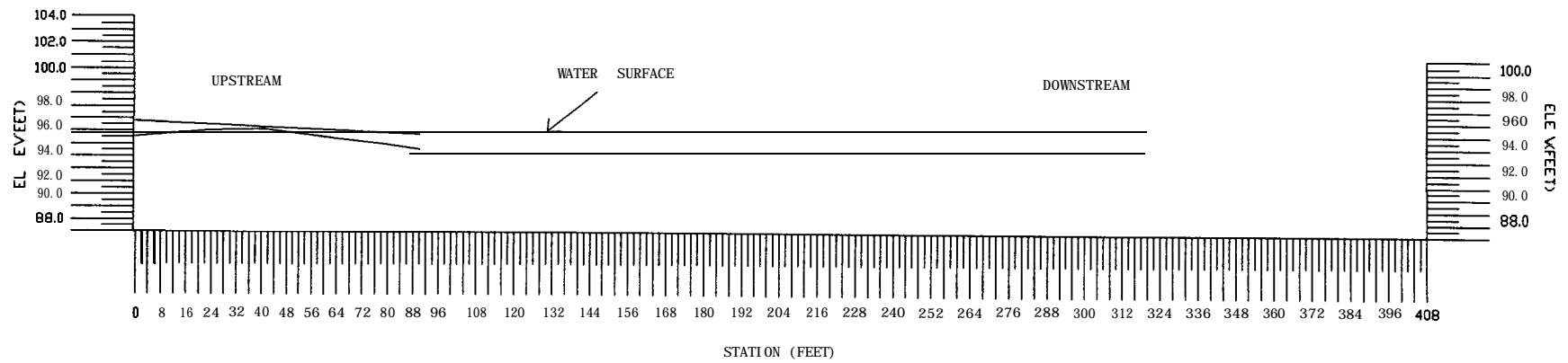


FIGURE 8: THALWEG BOTTOM PROFILE, REACH #3

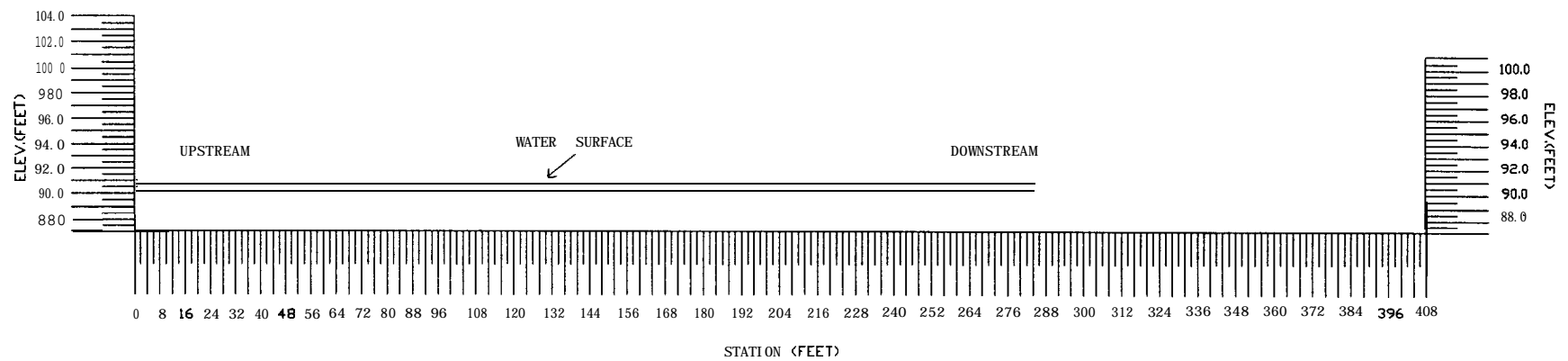


FIGURE 9: THALWEG BOTTOM PROFILE, REACH #4

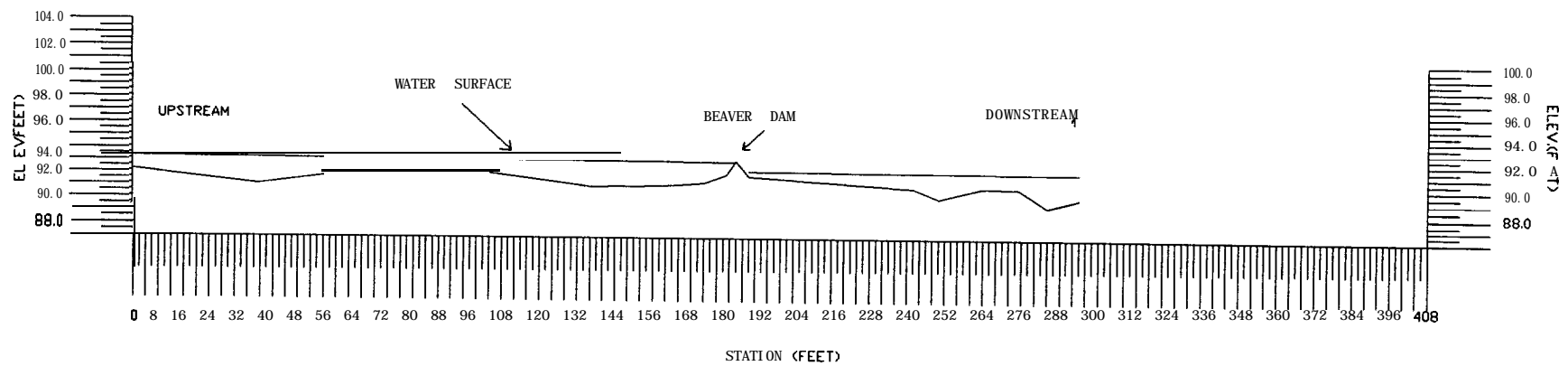


FIGURE 10: THALWEG BOTTOM PROFILE, REACH #5

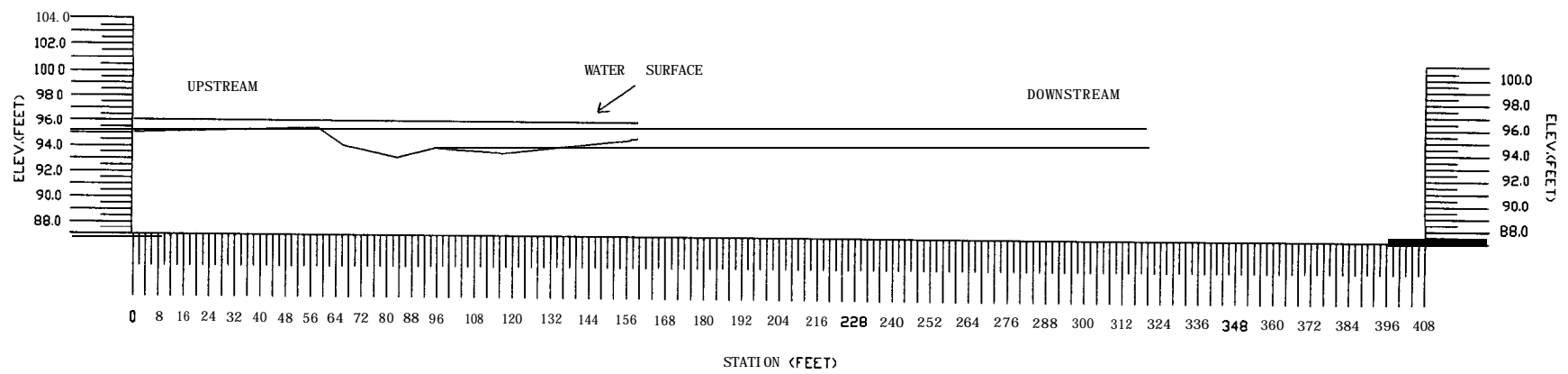


FIGURE 11: WATER VELOCITIES, REACH #1 – TRANSECT #1

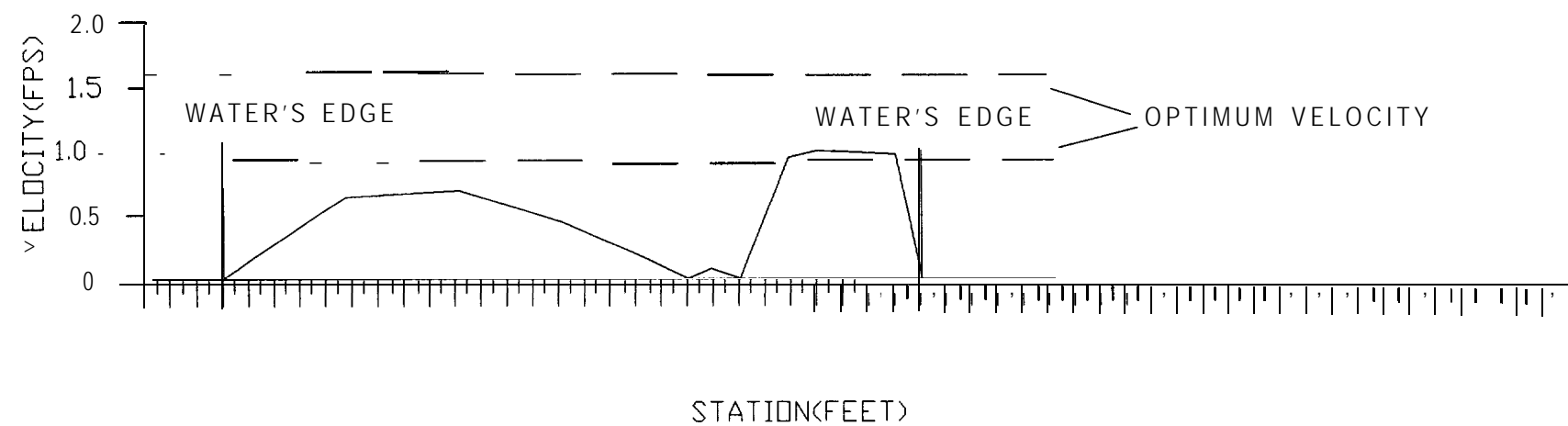


FIGURE 12: WATER VELOCITIES, REACH #1 - TRANSECT #2

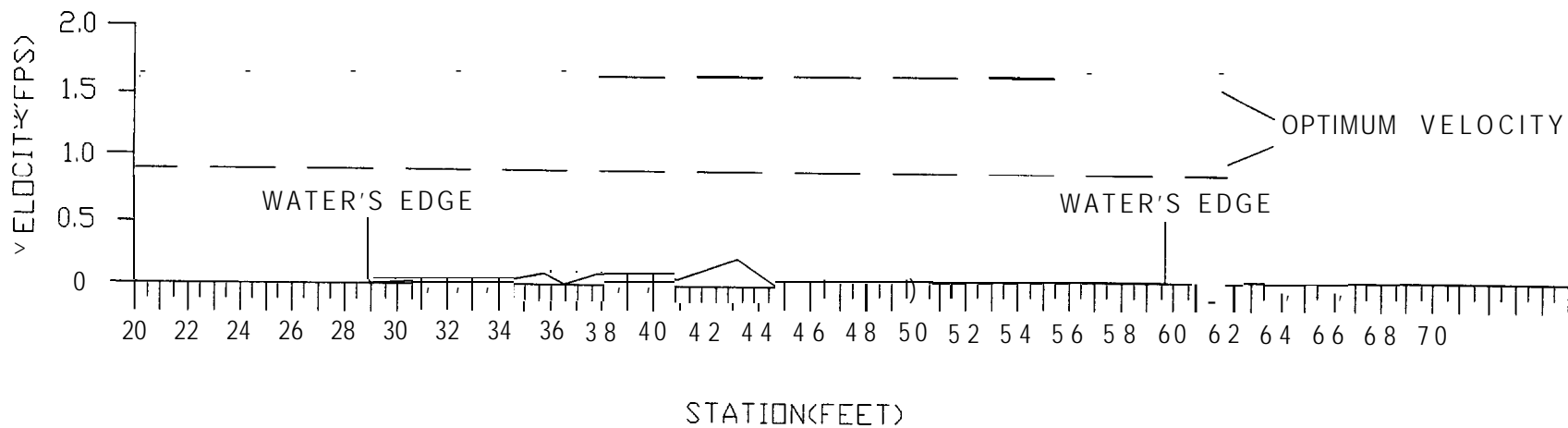




FIGURE 13: WATER VELOCITIES, REACH #1 – TRANSECT #3

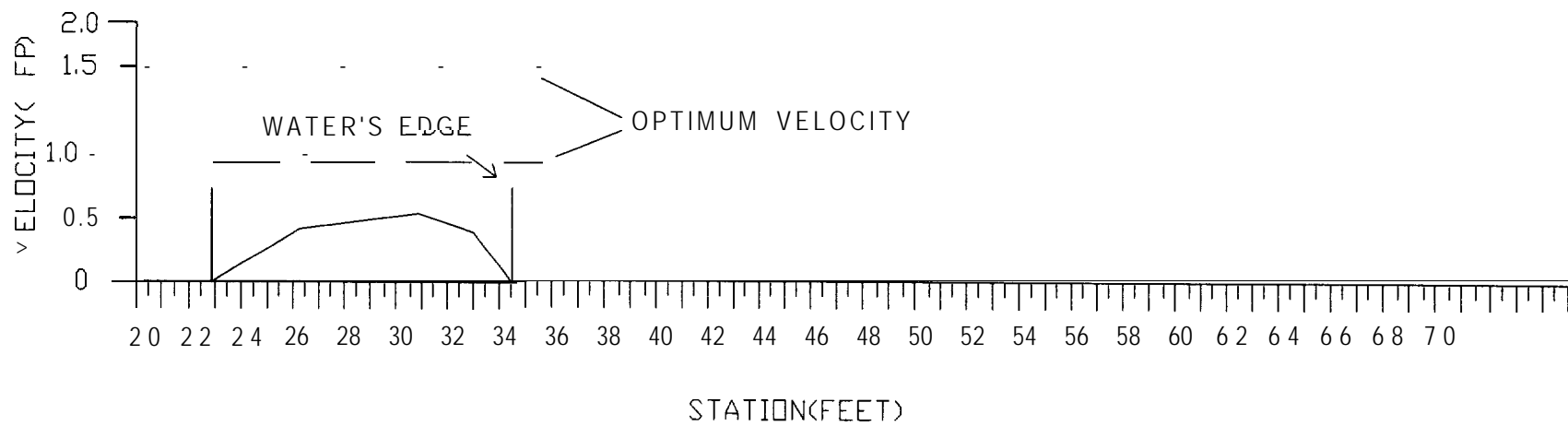


FIGURE 14: WATER VELOCITIES, REACH #2 – TRANSECT #1

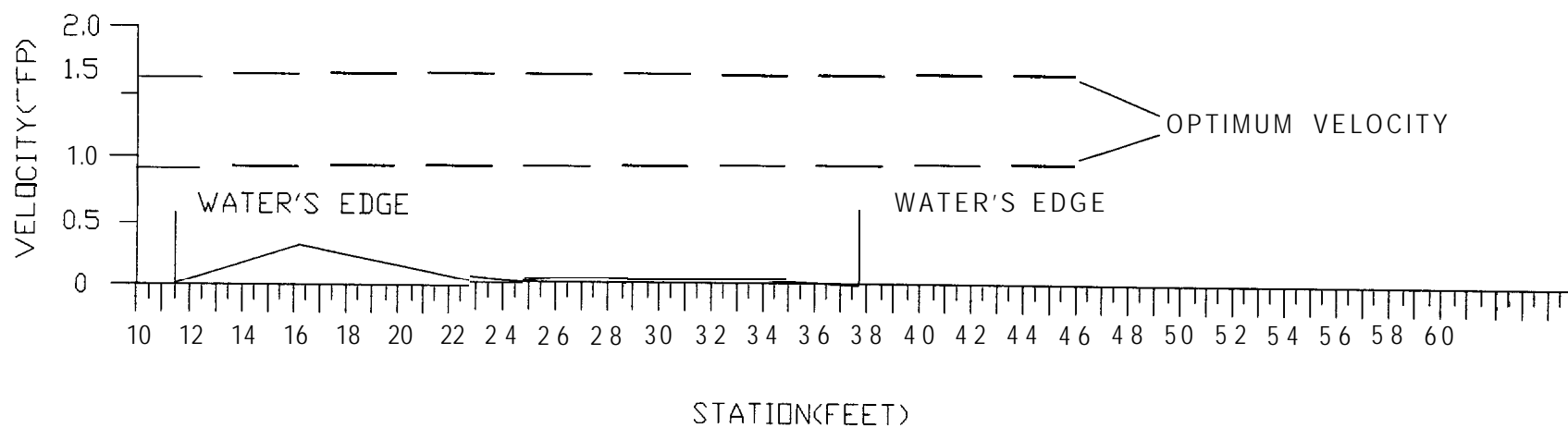


FIGURE 15: WATER VELOCITIES, REACH #2 - TRANSECT #2

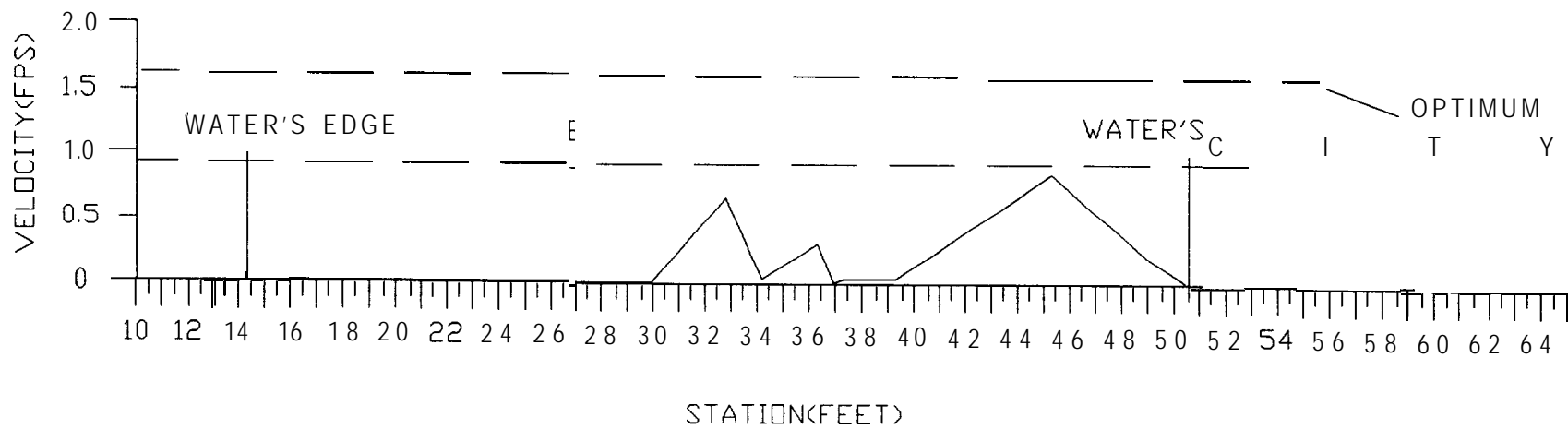


FIGURE 16: WATER VELOCITIES, REACH #2 – TRANSECT #3

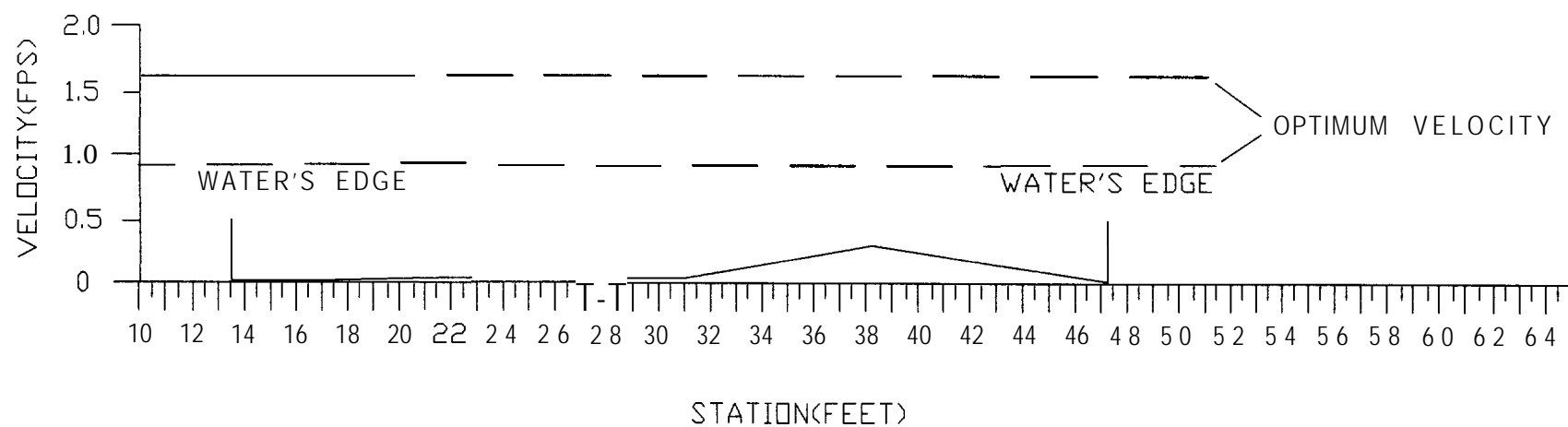


FIGURE 17: WATER VELOCITIES, REACH #3 - TRANSECT #1

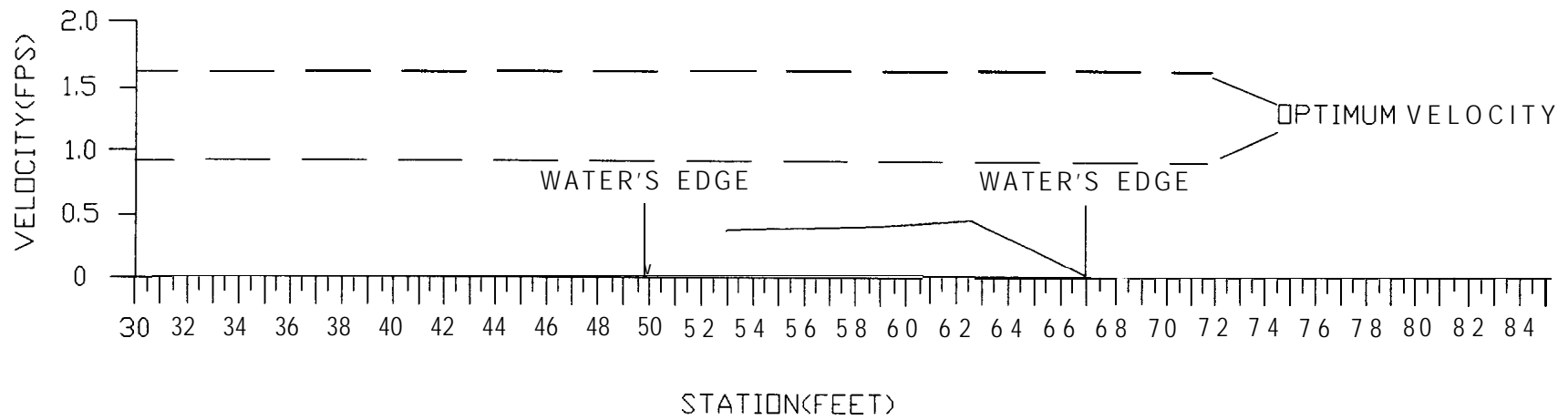


FIGURE 18: WATER VELOCITIES, REACH #3 – TRANSECT #2

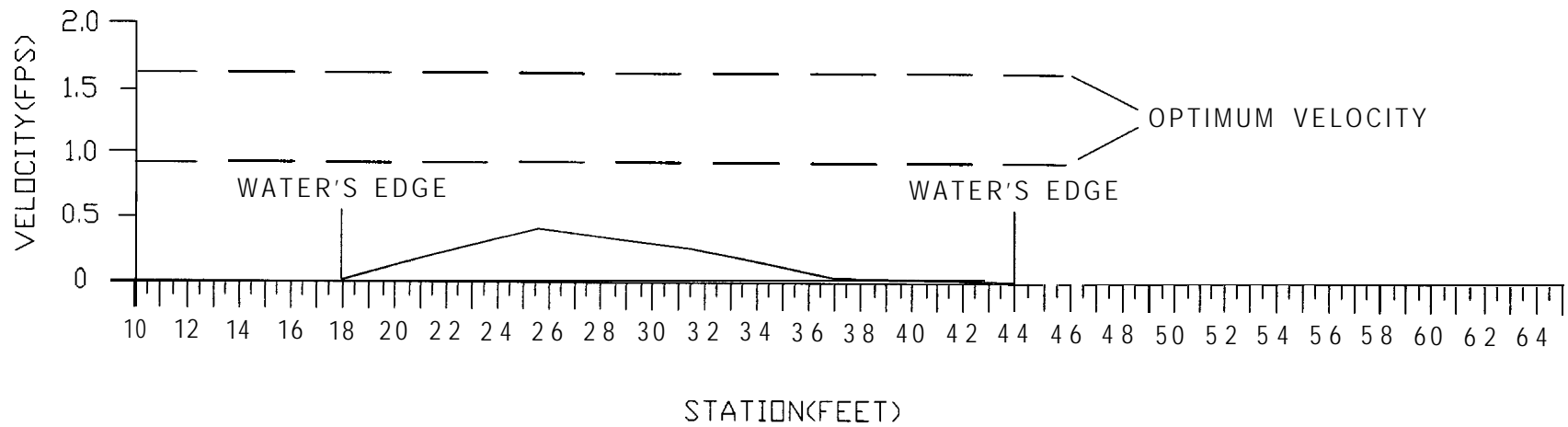


FIGURE 19: WATER VELOCITIES, REACH #3 - TRANSECT #3

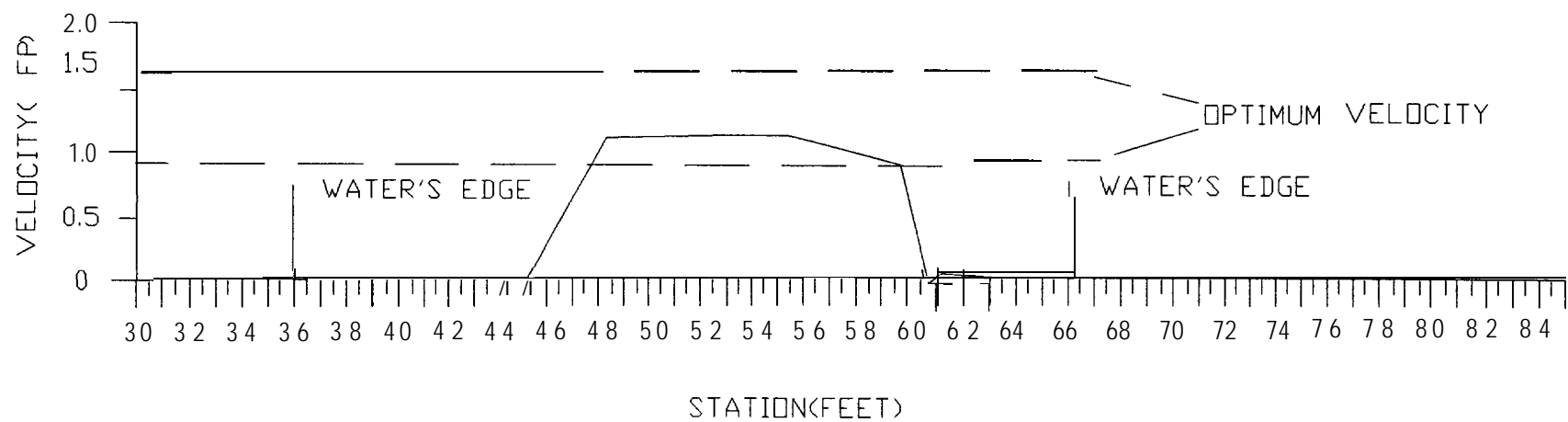


FIGURE 20: WATER VELOCITIES, REACH #4 - TRANSECT #1

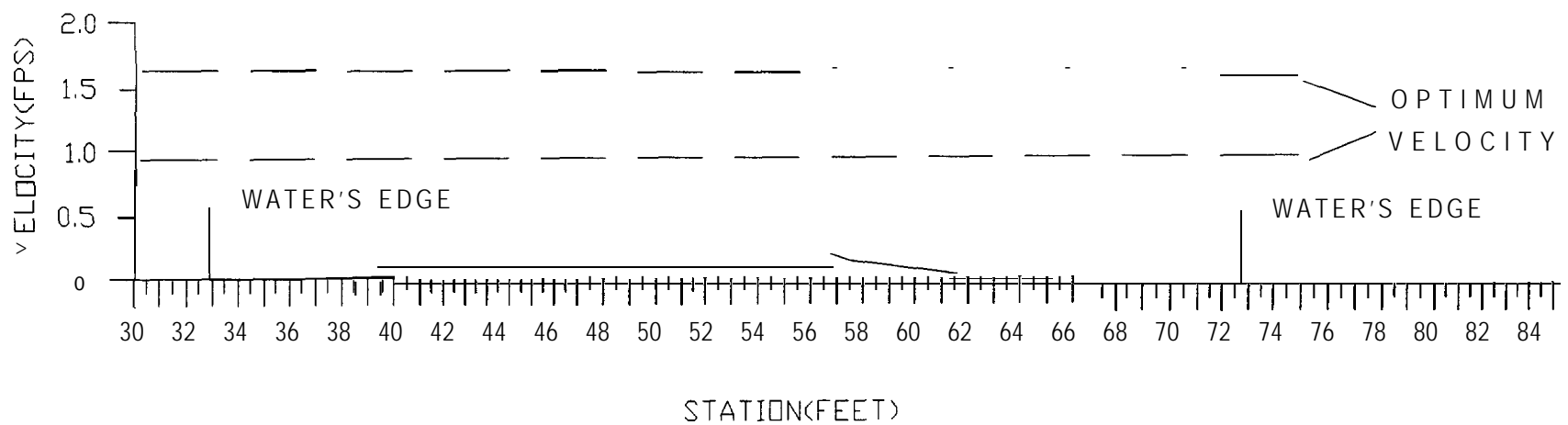




FIGURE 21: WATER VELOCITIES, REACH #4 – TRANSECT #2

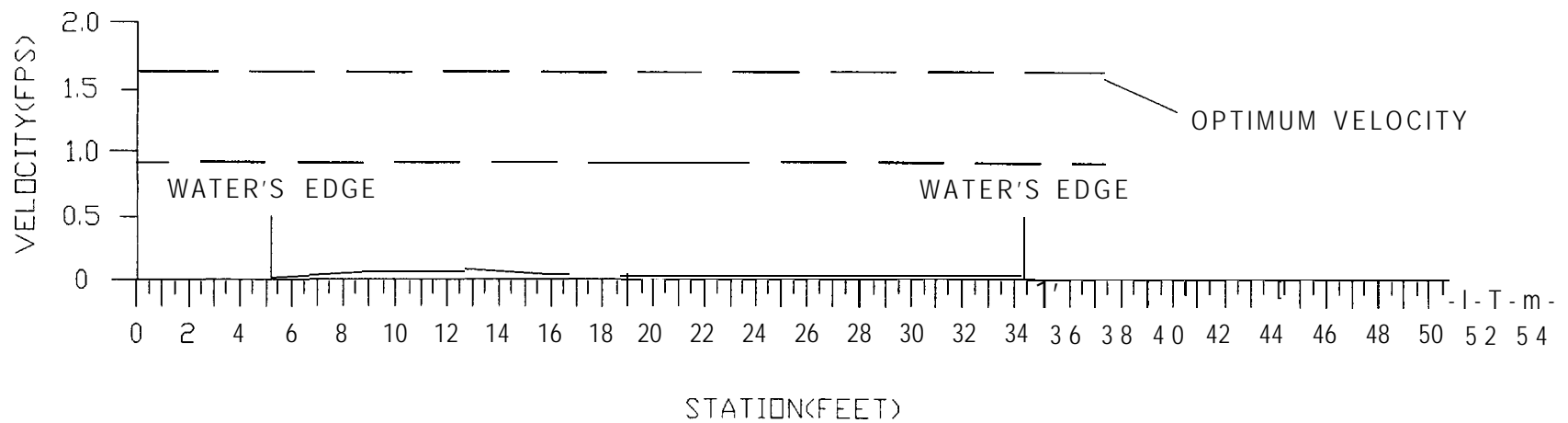


FIGURE 22: WATER VELOCITIES, REACH #4 – TRANSECT #3

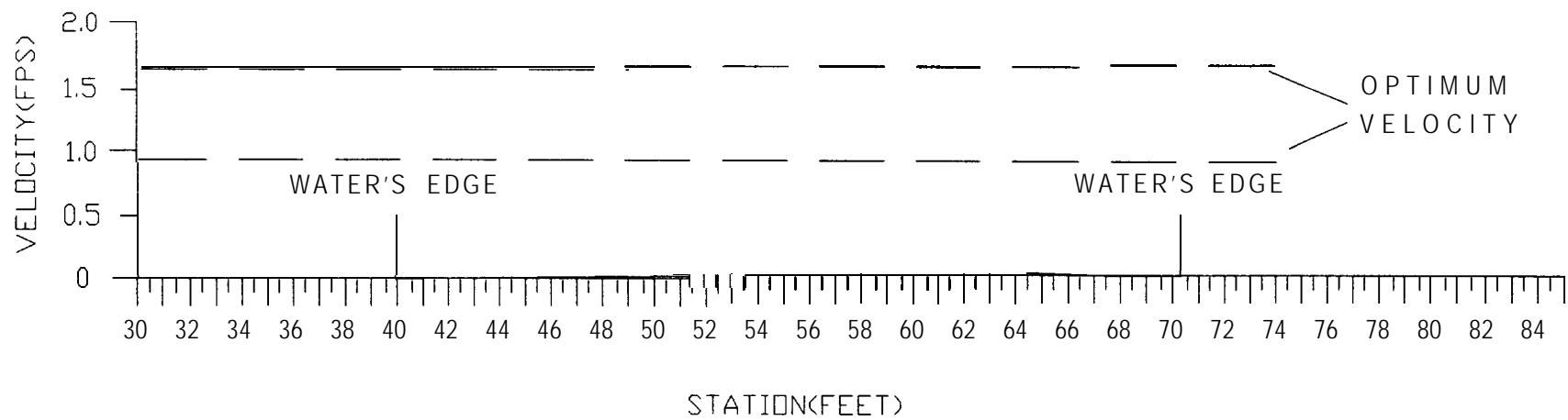


FIGURE 23: WATER VELOCITIES, REACH #5 - TRANSECT #1

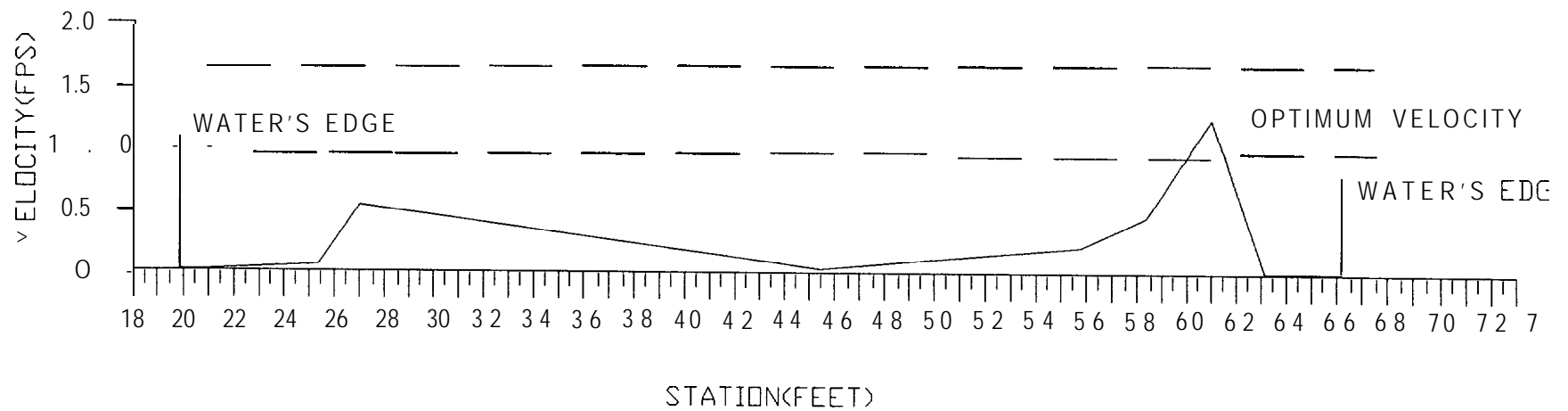


FIGURE 24: WATER VELOCITIES, REACH #5 - TRANSECT #2

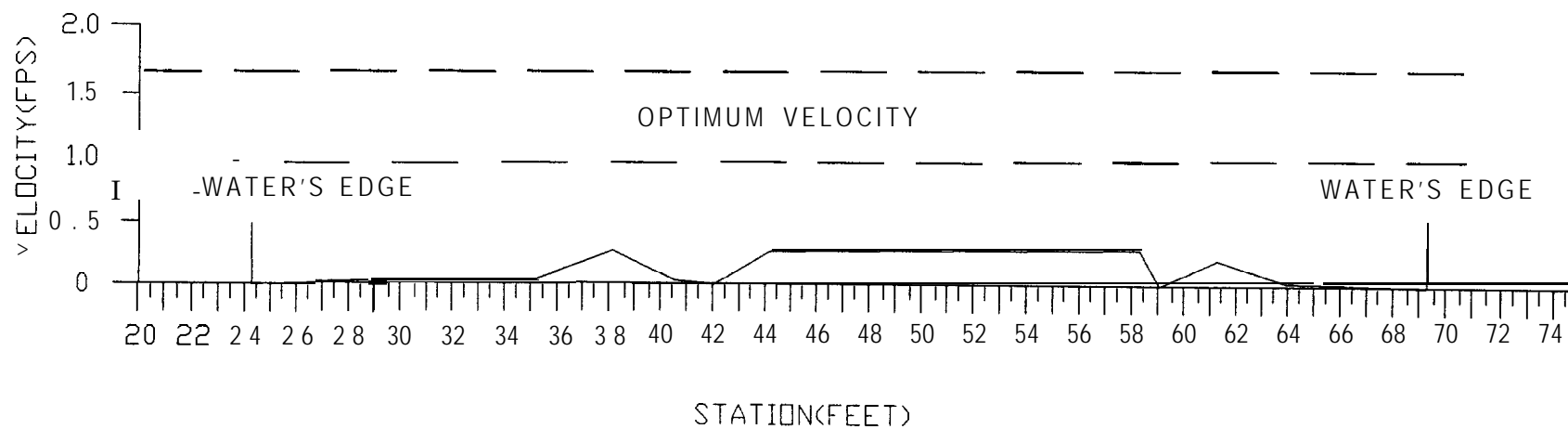


FIGURE 25: WATER VELOCITIES, REACH #5 - TRANSECT #3

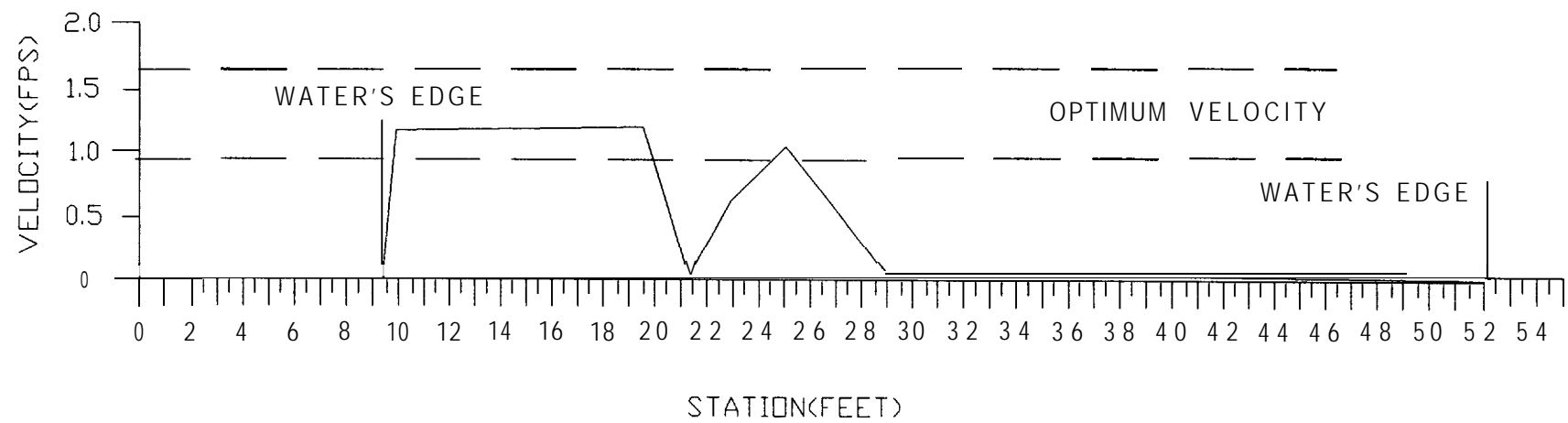


FIGURE 26: WATER VELOCITIES, REACH #1 - THALWEG

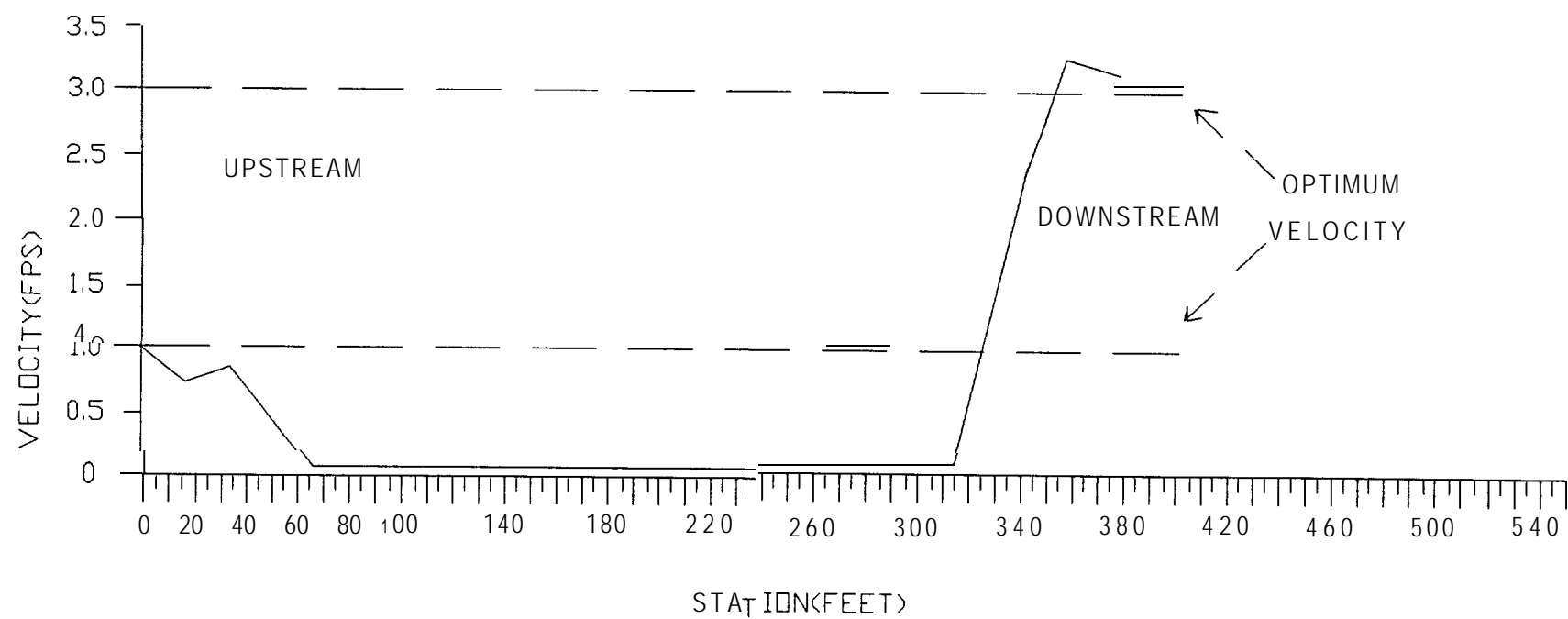


FIGURE 27: WATER VELOCITIES, REACH #2 - THALWEG

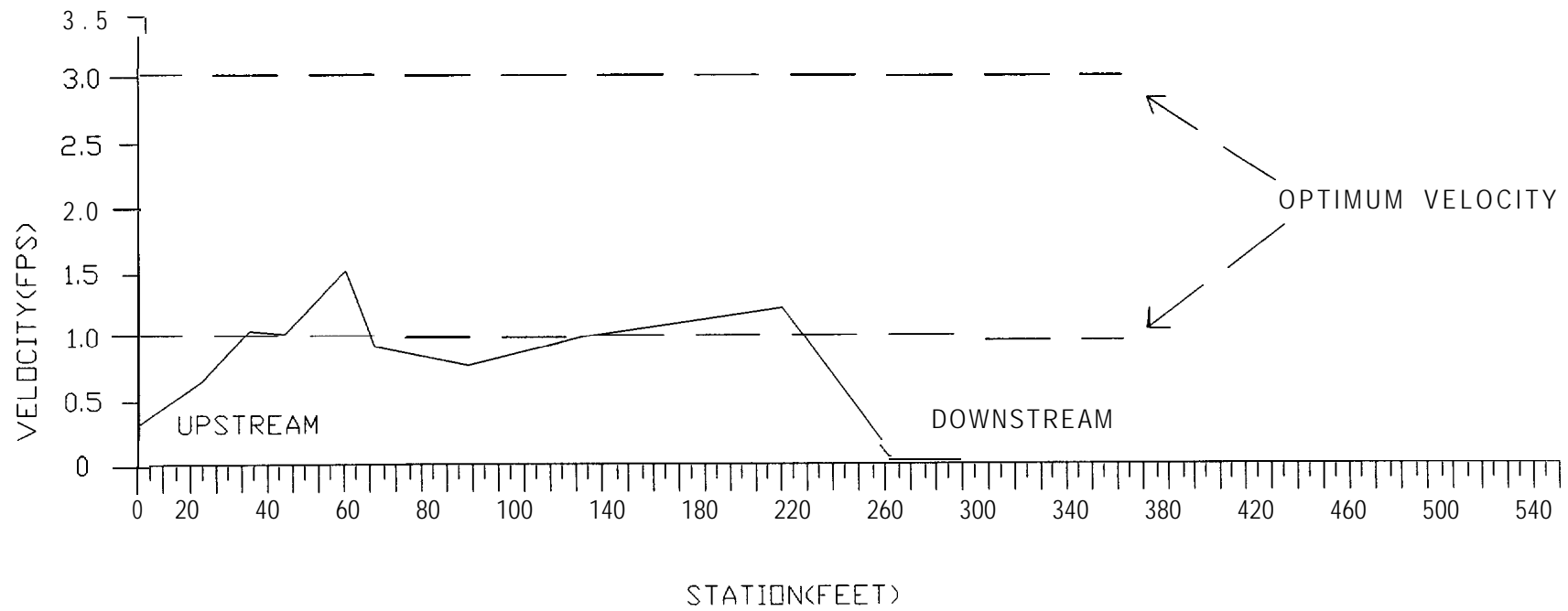


FIGURE 28: WATER VELOCITIES, REACH #3 - THALWEG

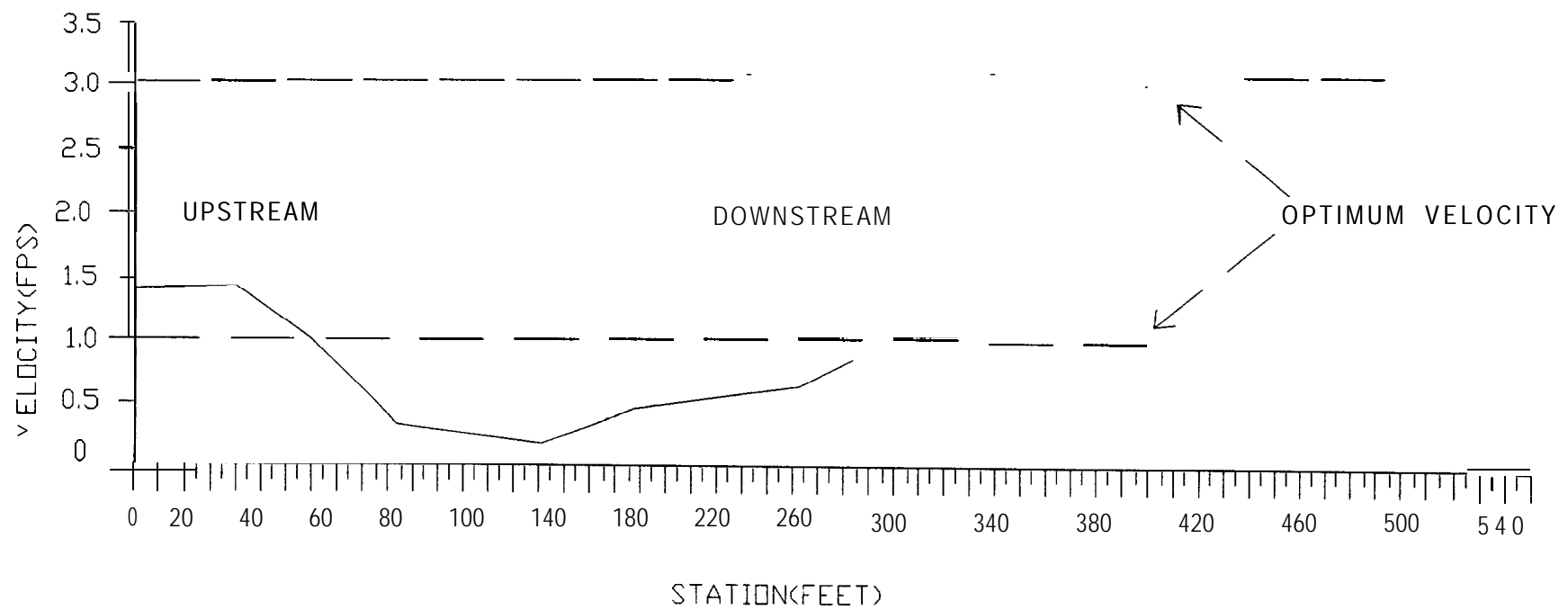




FIGURE 29: WATER VELOCITIES, REACH #4 – THALWEG

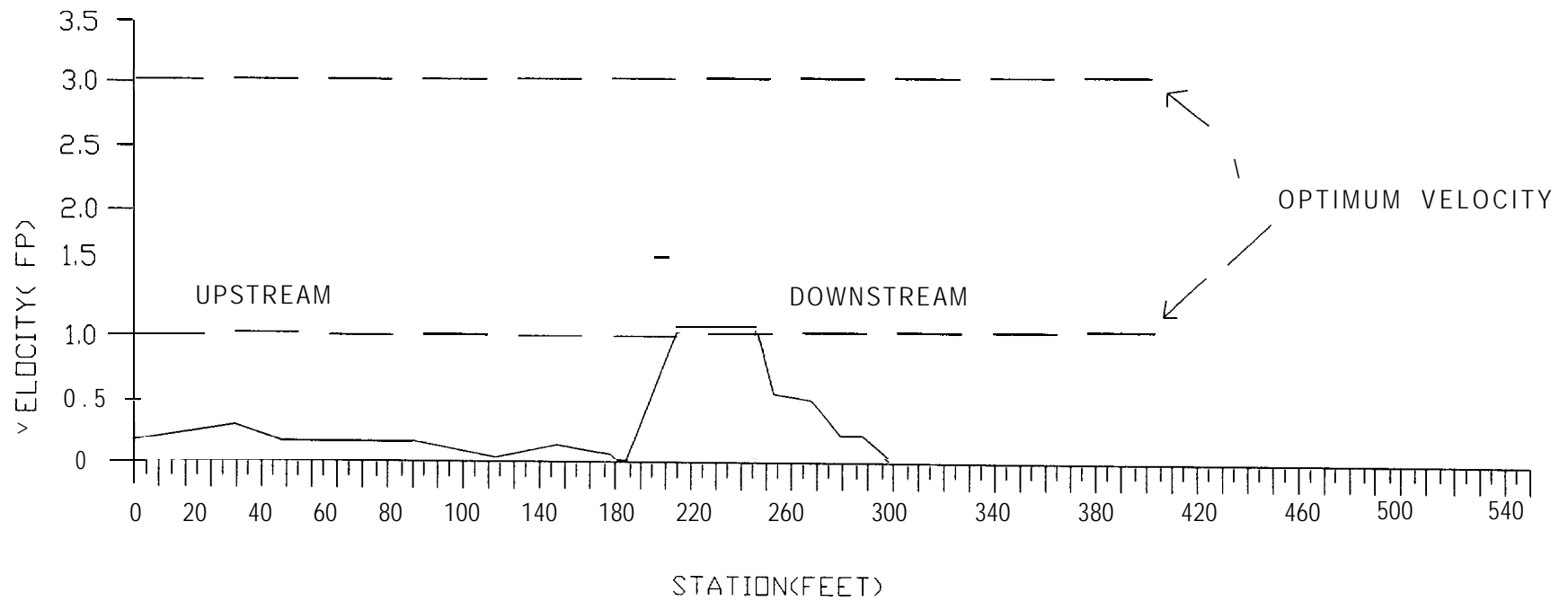


FIGURE 30: WATER VELOCITIES, REACH #5 - THALWEG

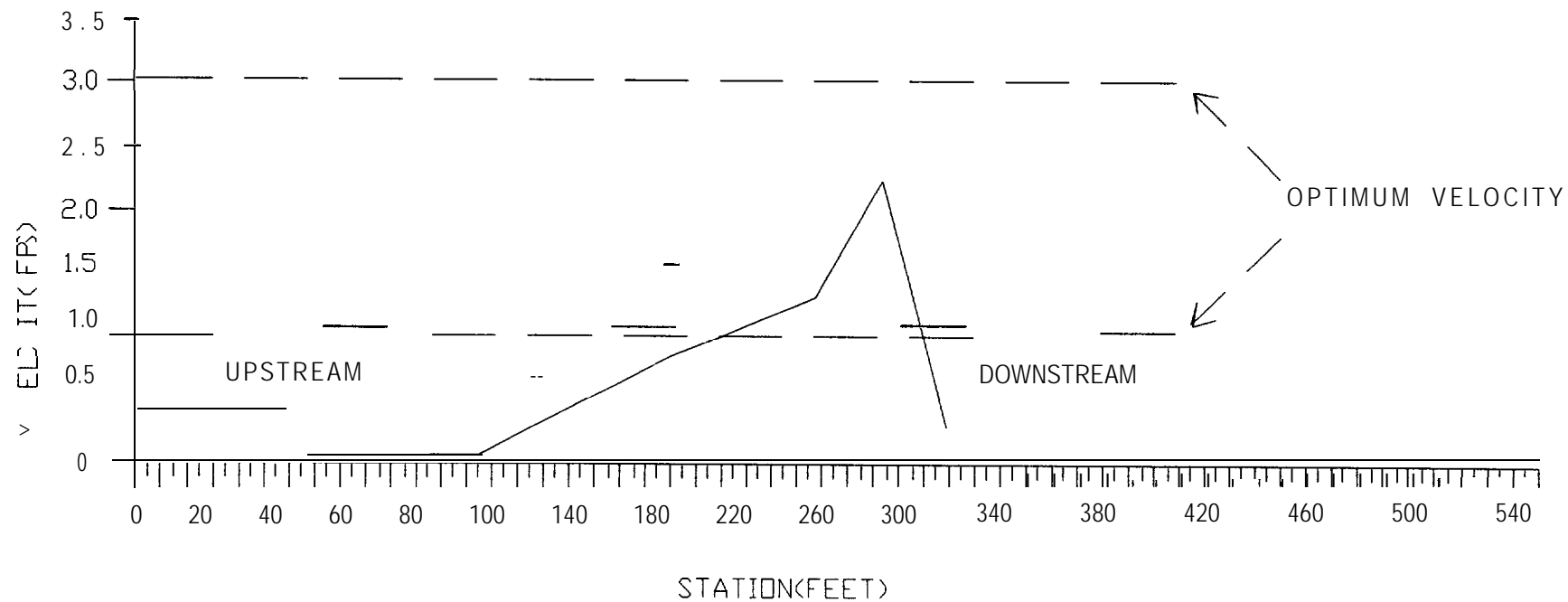


FIGURE 31: TRANSECT DEPTHS, REACH #1

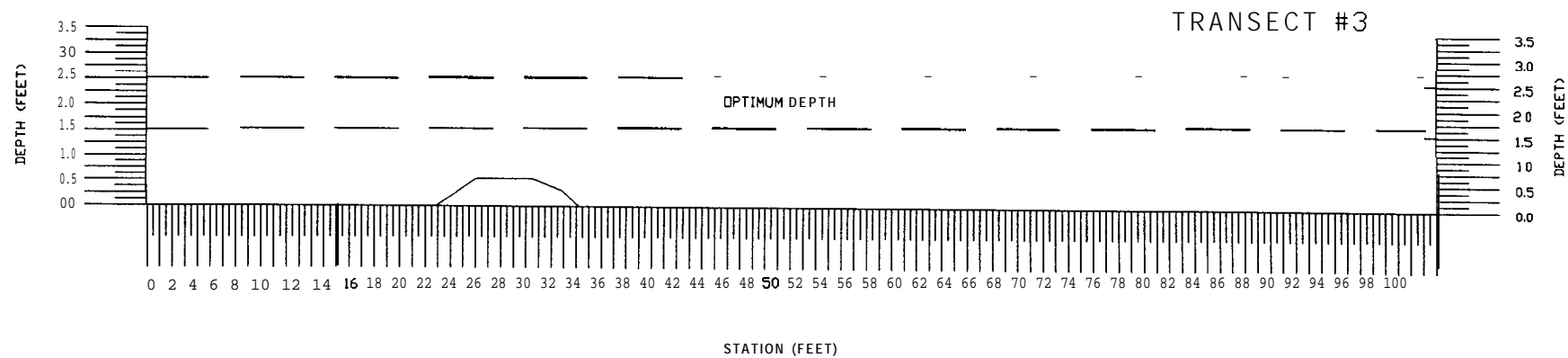
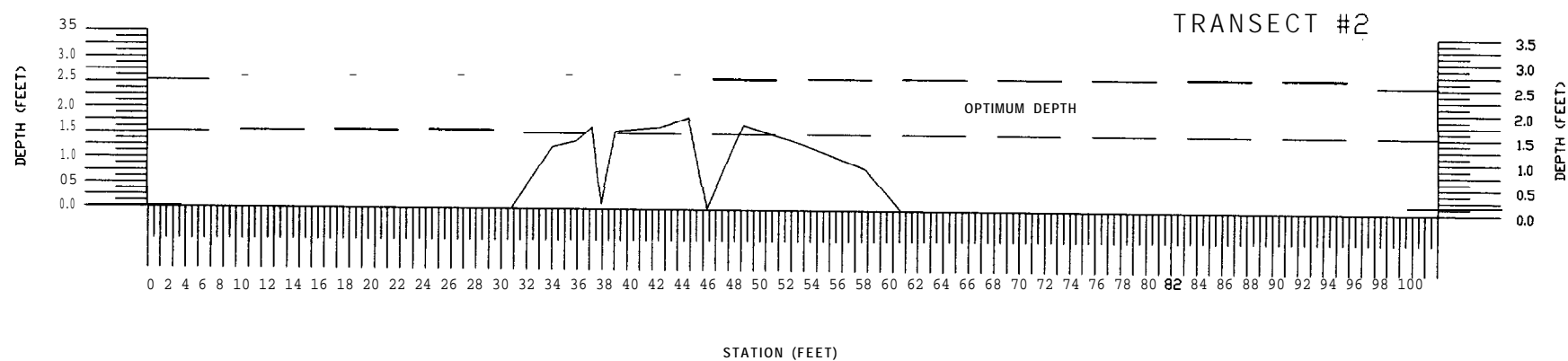
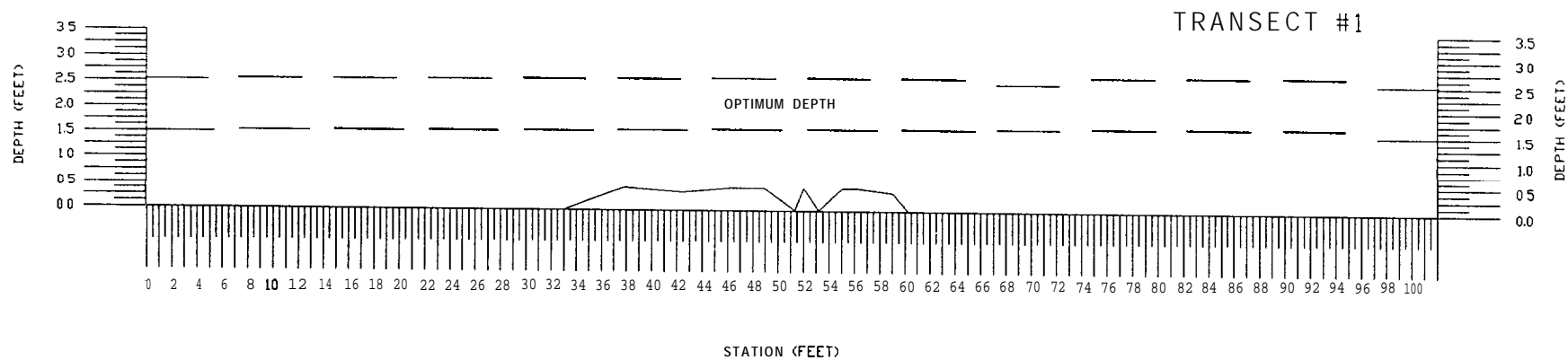


FIGURE 32: TRANSECT DEPTHS, REACH #2

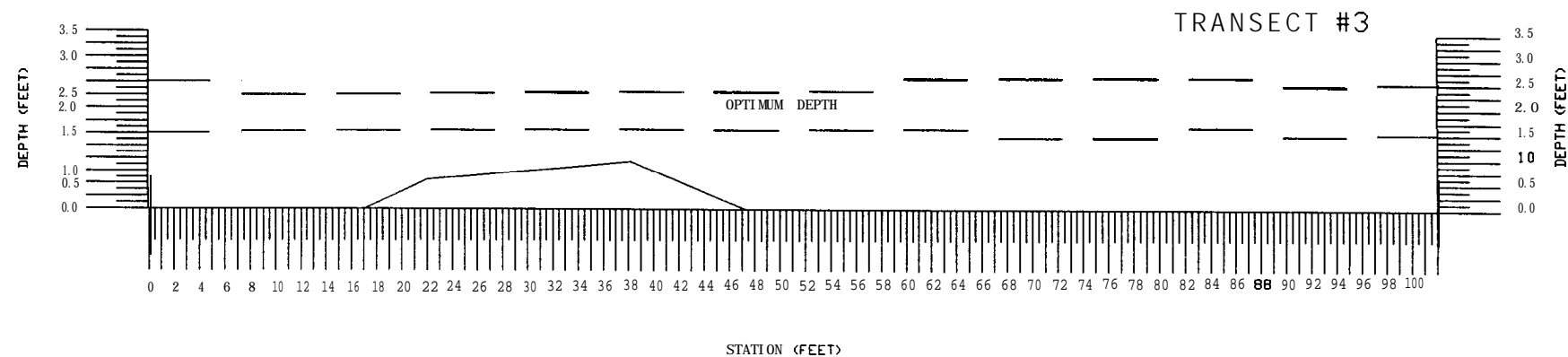
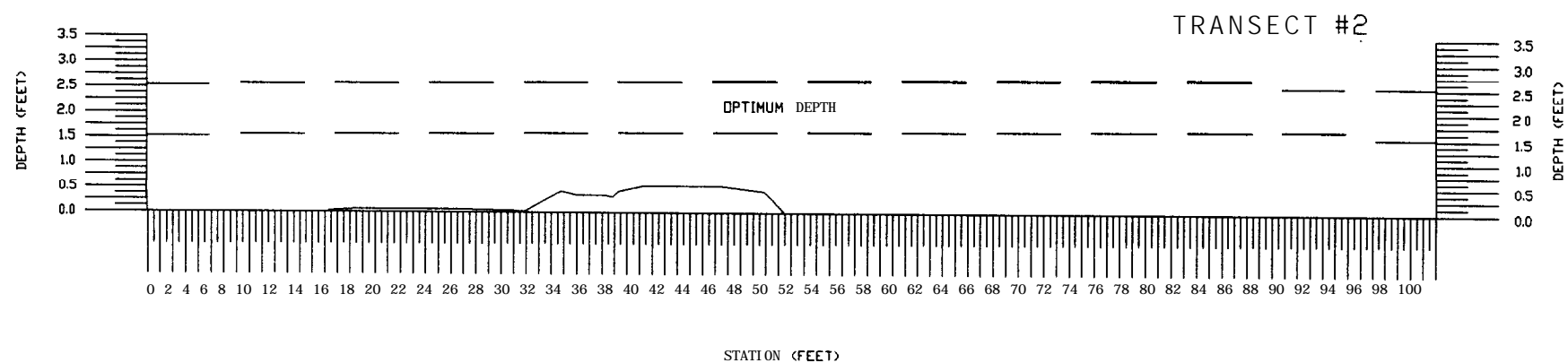
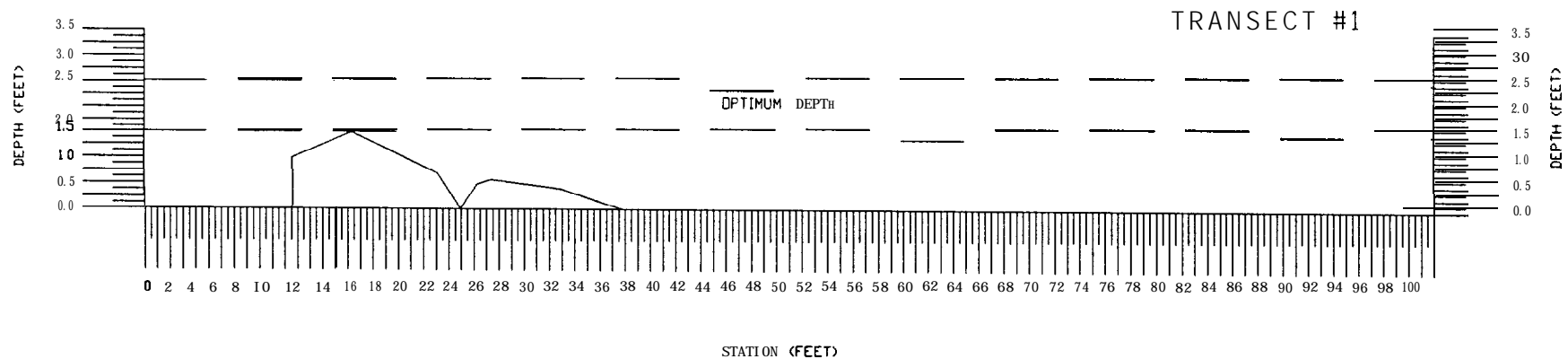


FIGURE 33: TRANSECT DEPTHS, REACH #3

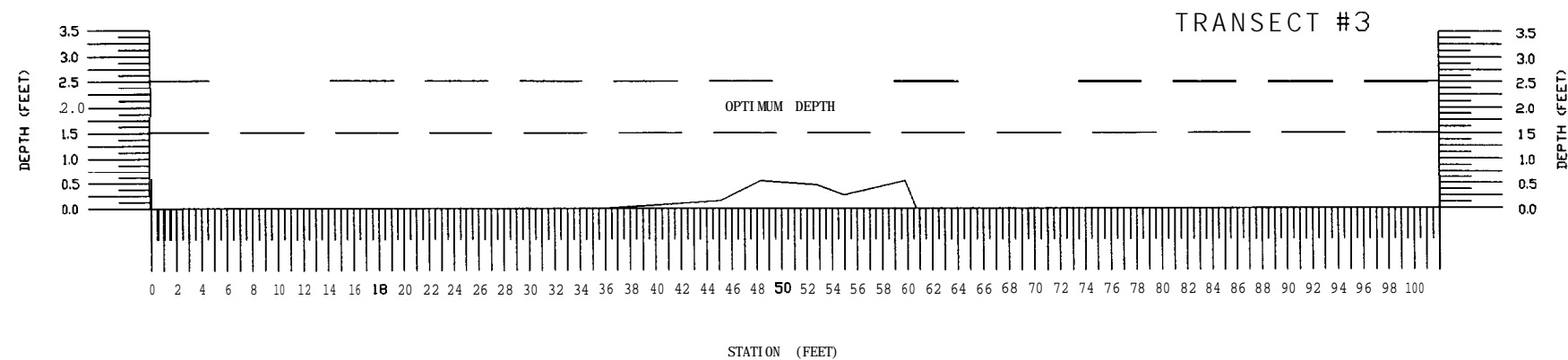
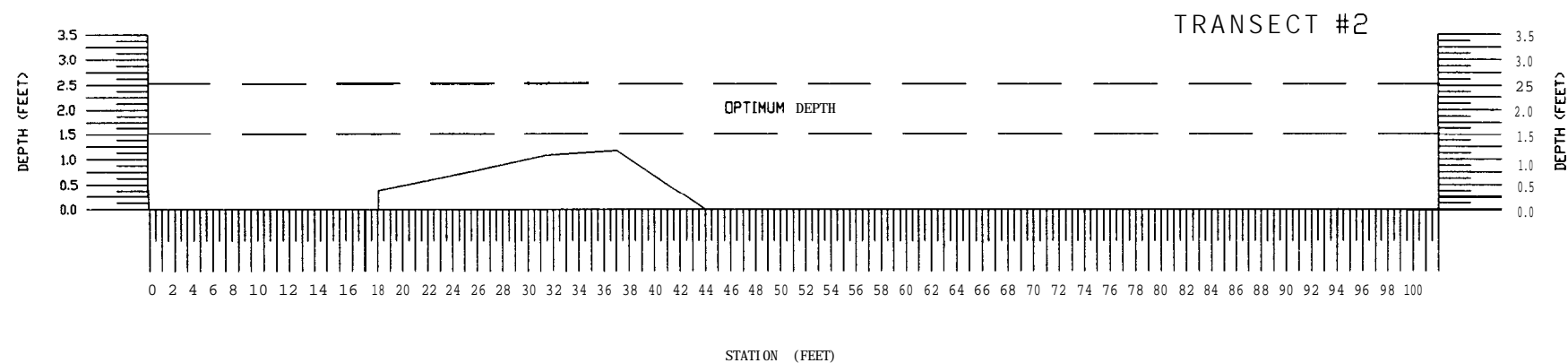
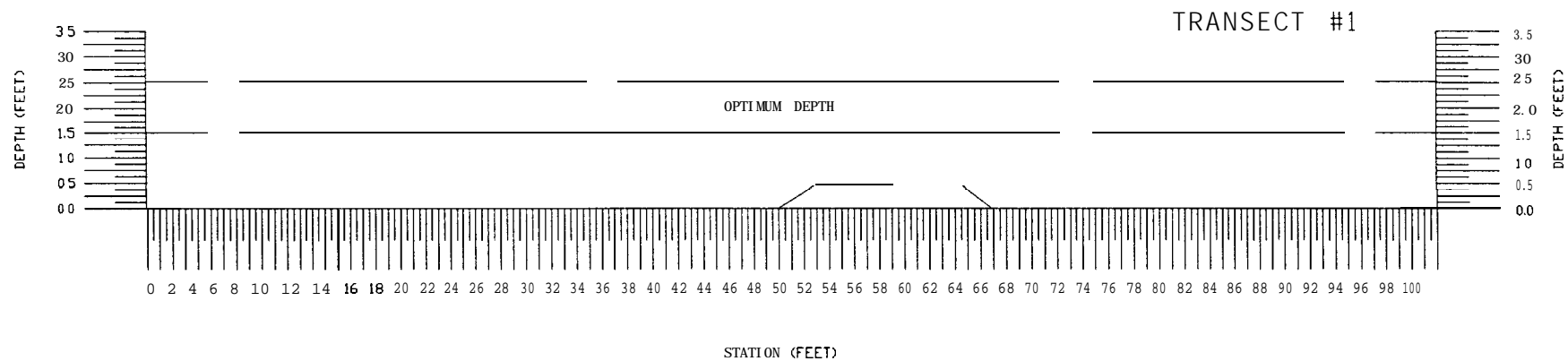


FIGURE 34: TRANSECT DEPTHS, REACH #4

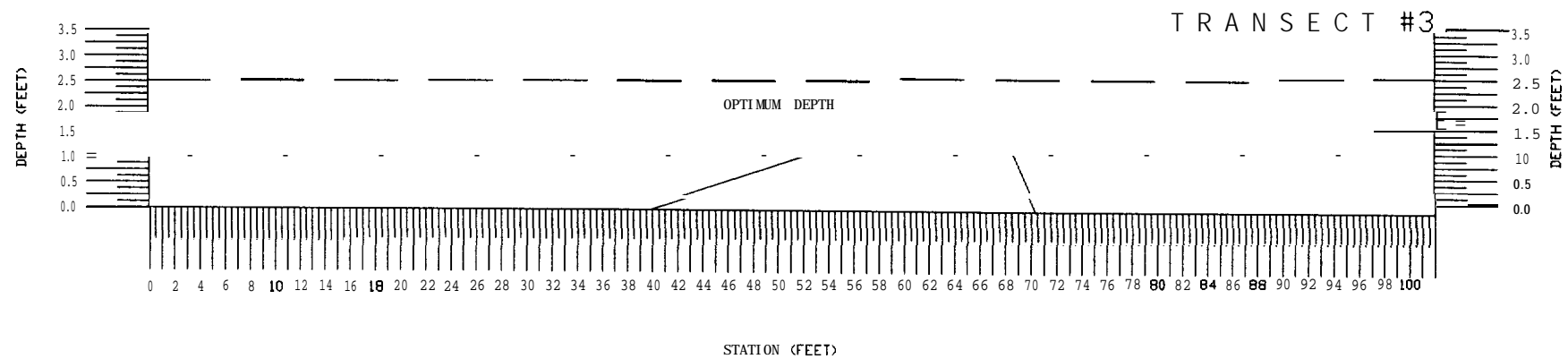
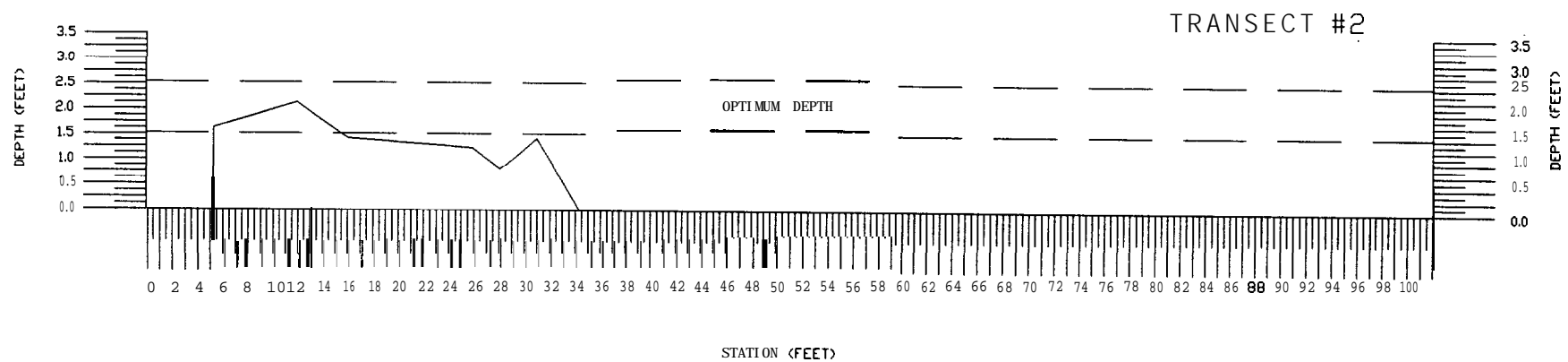
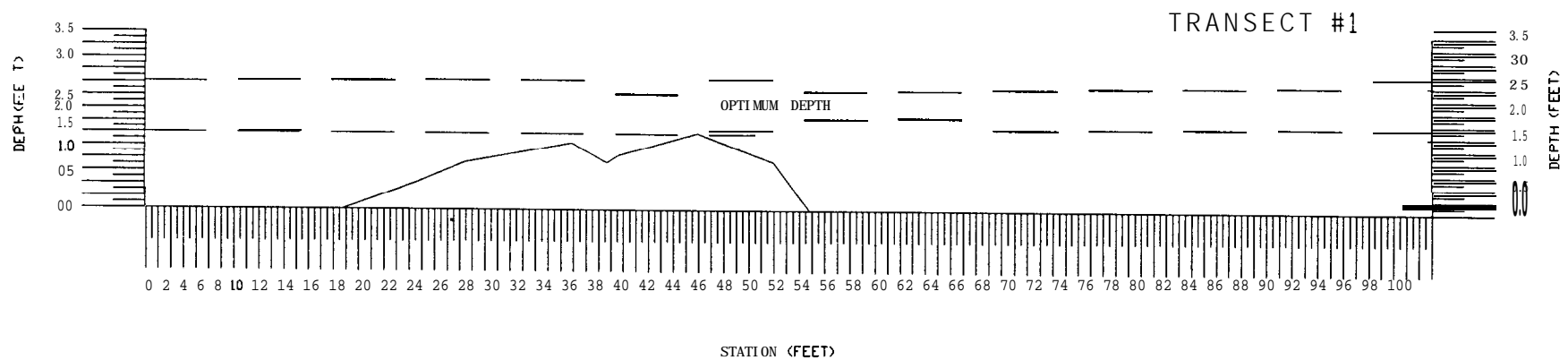


FIGURE 35: TRANSECT DEPTHS, REACH #5

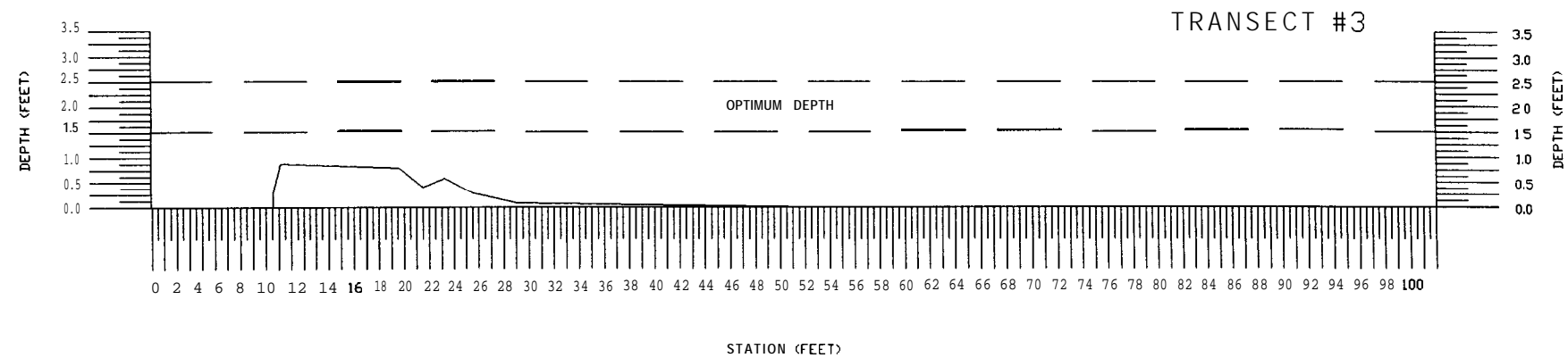
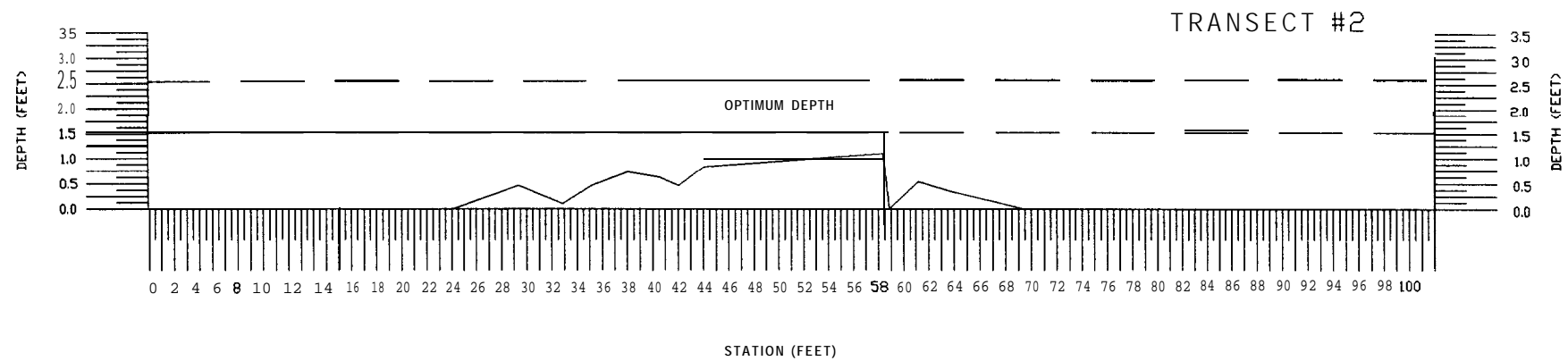
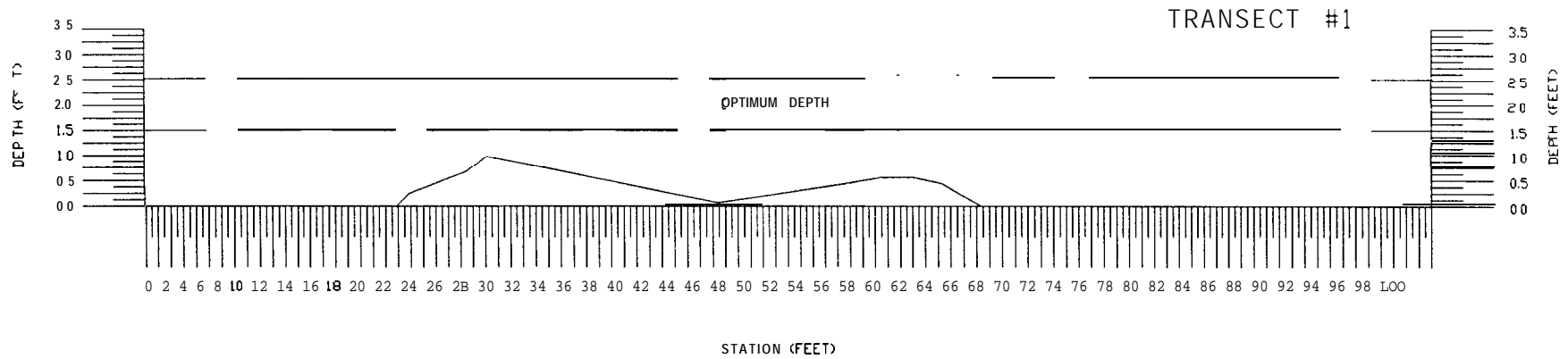


FIGURE 36: THALWEG DEPTHS, REACH #1

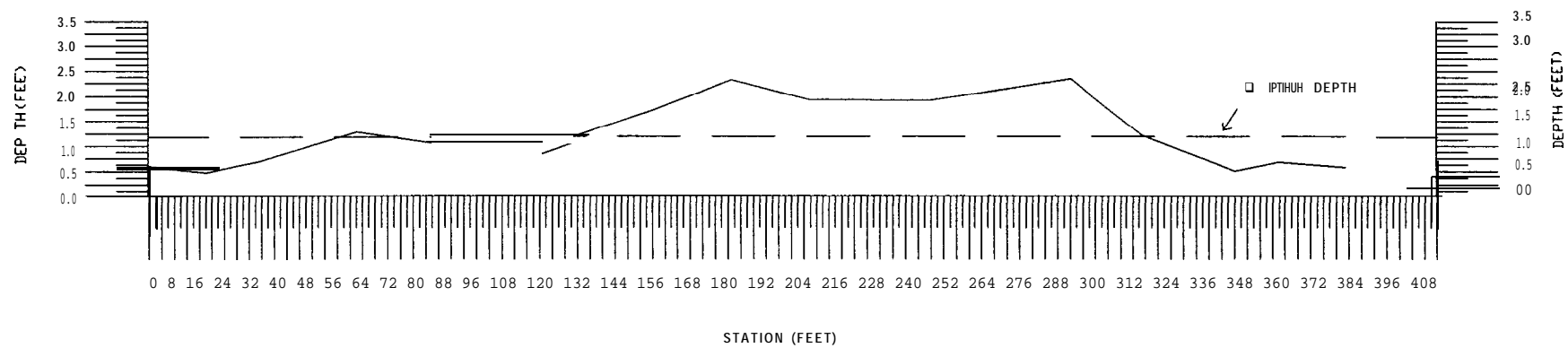




FIGURE 37: THALWEG DEPTHS, REACH #2

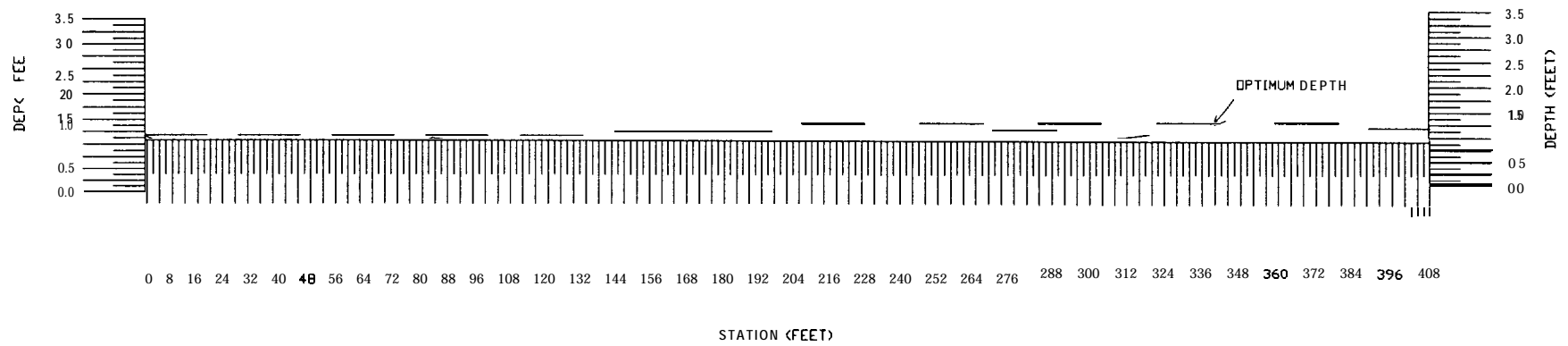


FIGURE 38: THALWEG DEPTHS, REACH #3

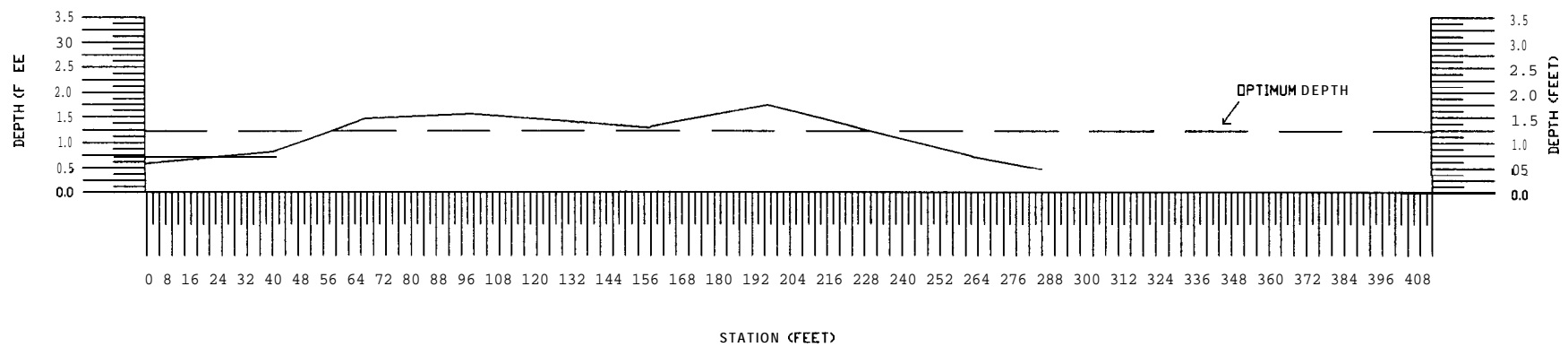


FIGURE 39: THALWEG DEPTHS, REACH #4

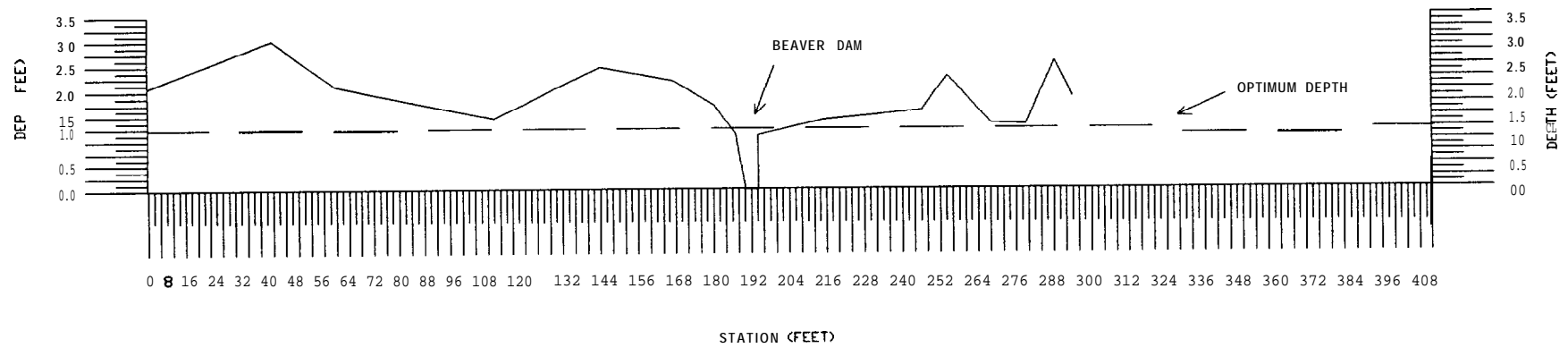


FIGURE 40: THALWEG DEPTHS, REACH #5

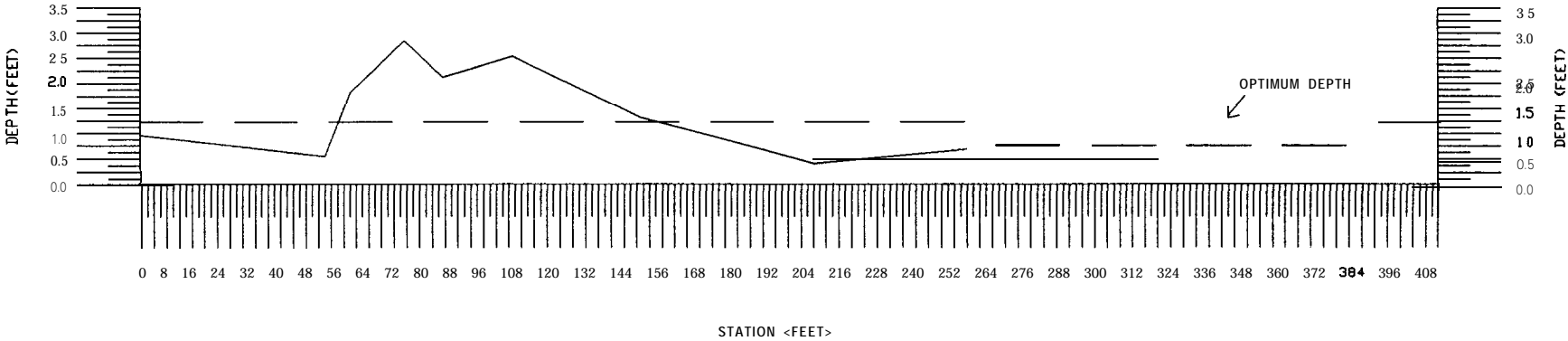
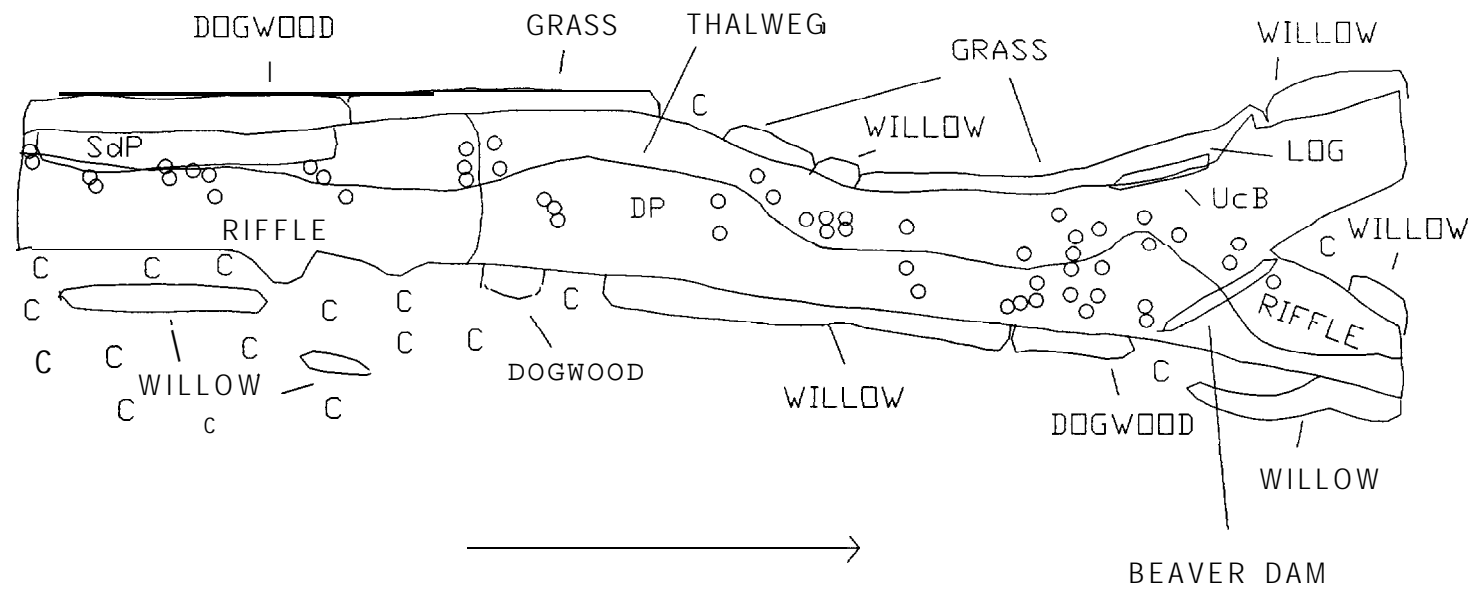


FIGURE 41: COVER MAP, REACH #1



C=COBBLE

O=BOULDER

DP=DEEP POOL

SdP=SHADED POOL

UcB=UNDERCUT BANK

FIGURE 42: COVER MAP, REACH #2

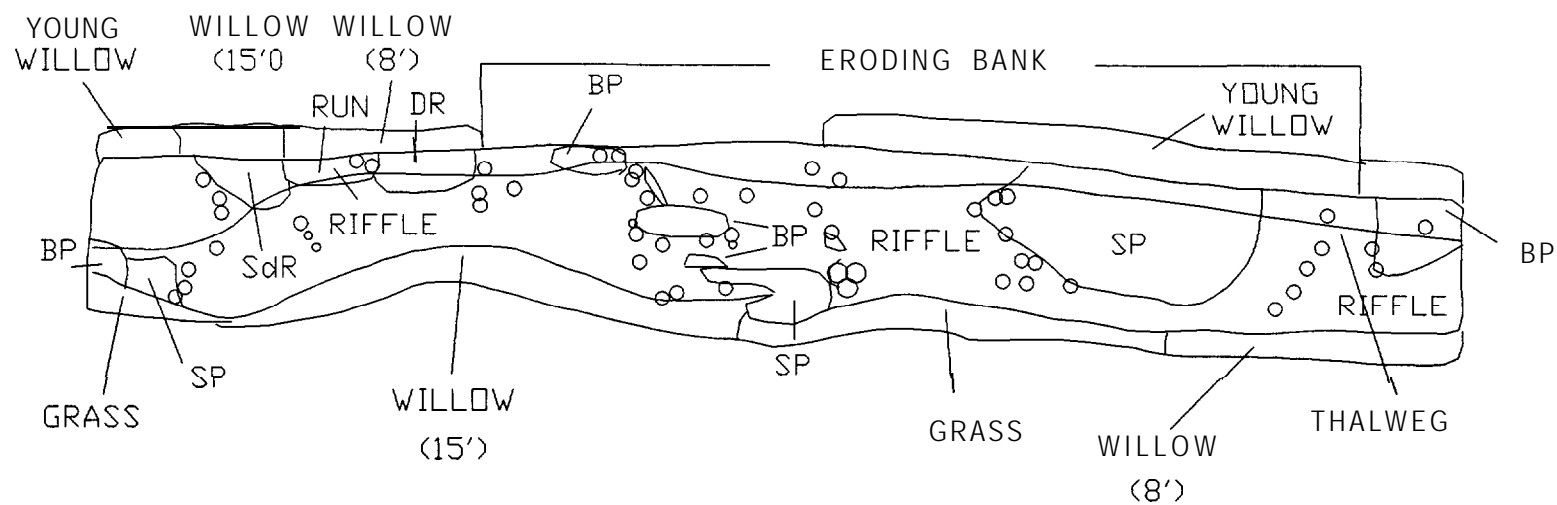
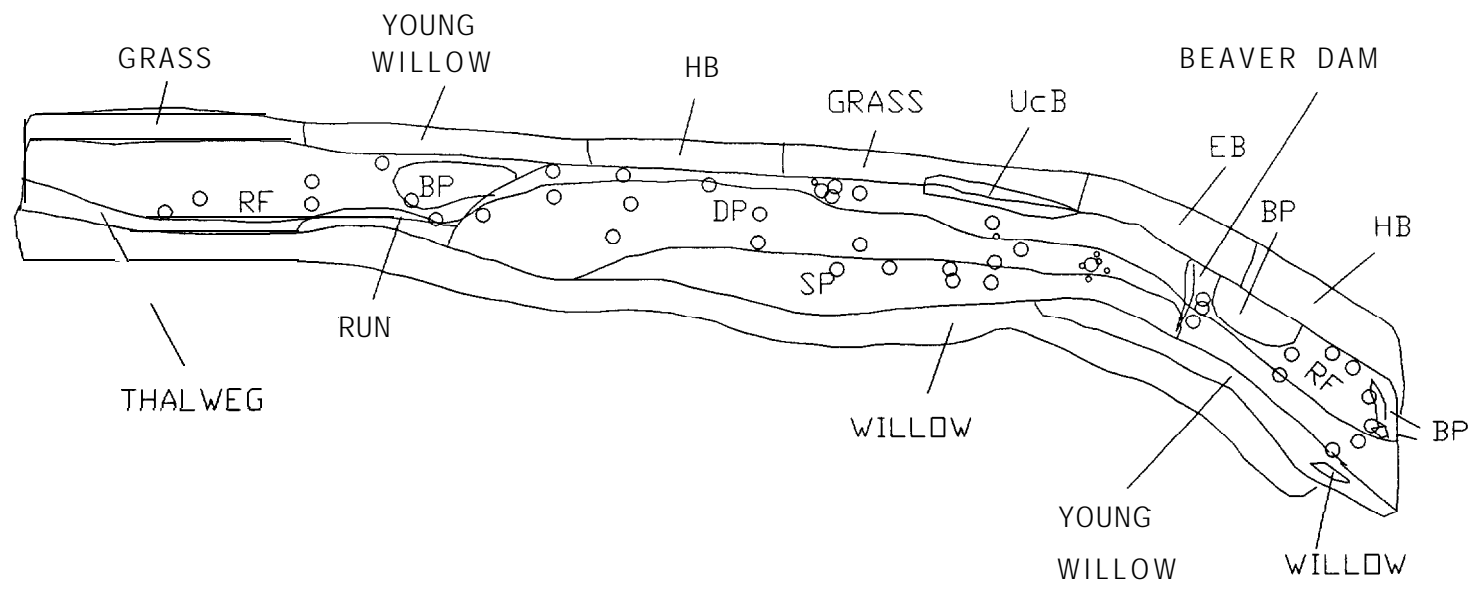


FIGURE 43: COVER MAP, REACH #3



BP=BOULDER POOL

HP=HEALING BANK

RF=RIFFLE

EB=ERODING BANK

O=BOULDER

DP=DEEP POOL

SP=SHALLOW POOL

UCB=UNDERCUT BANK

FIGURE 44: COVER MAP, PEACH #4

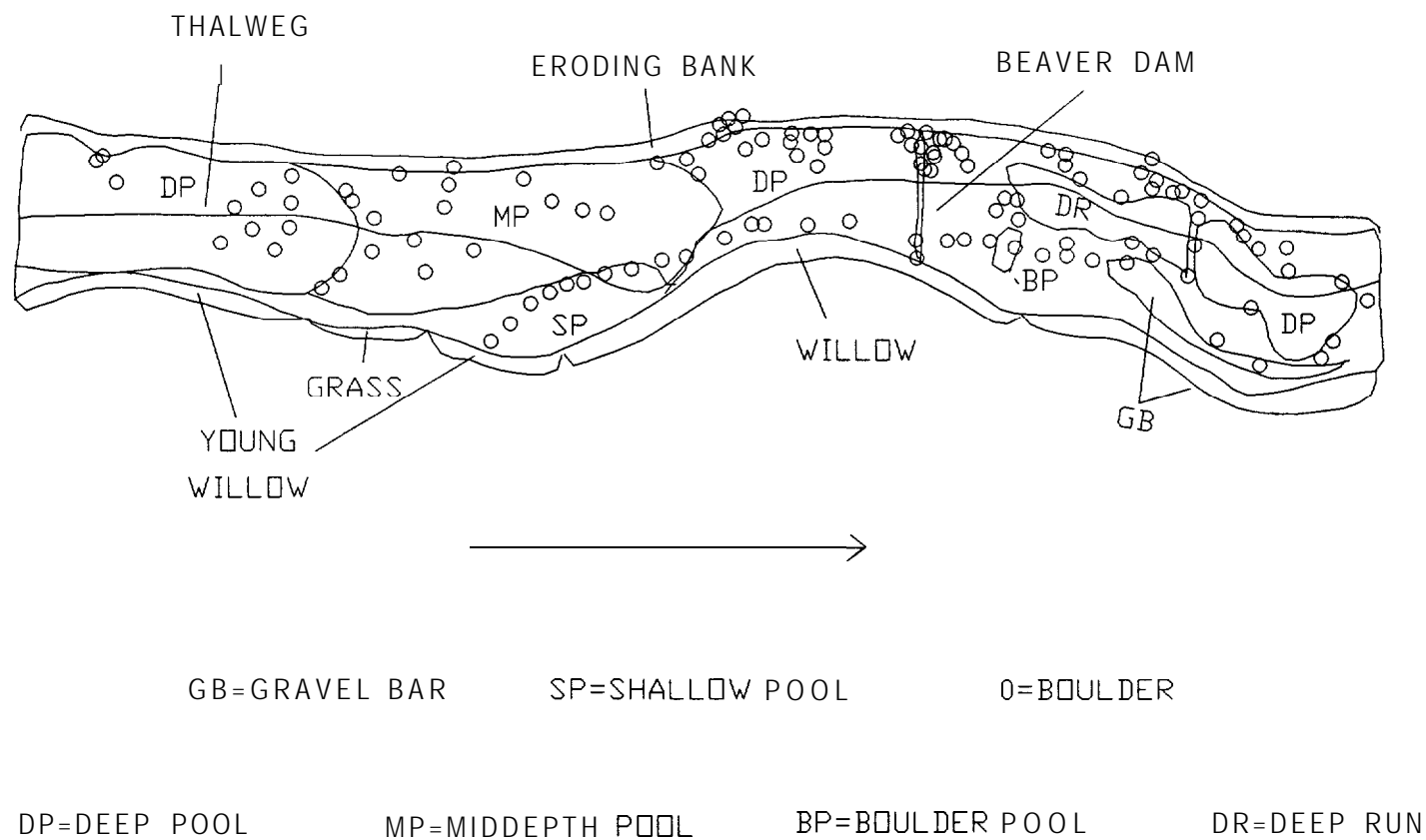




FIGURE 45: COVER MAP, REACH #5

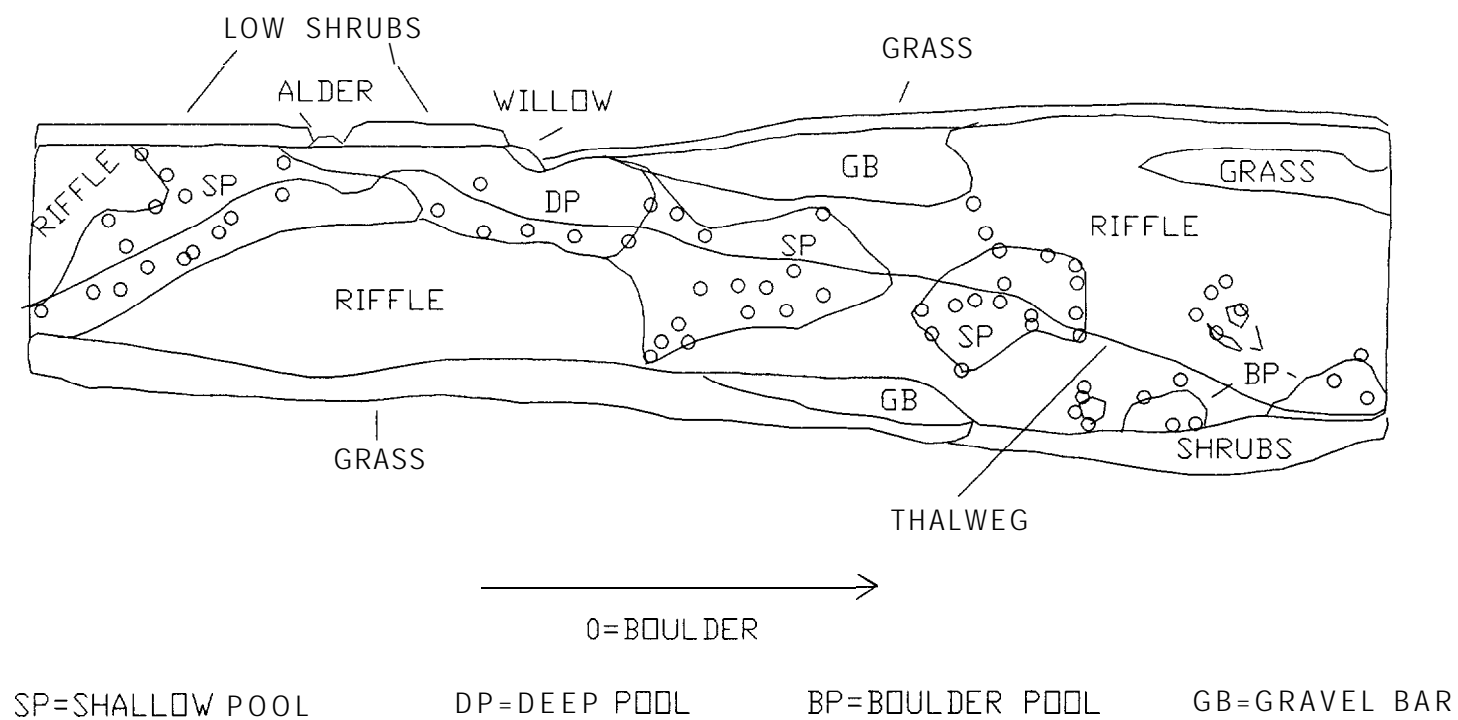


FIGURE 46: INSTREAM COVER (PERCENT OF TOTAL SURFACE AREA)

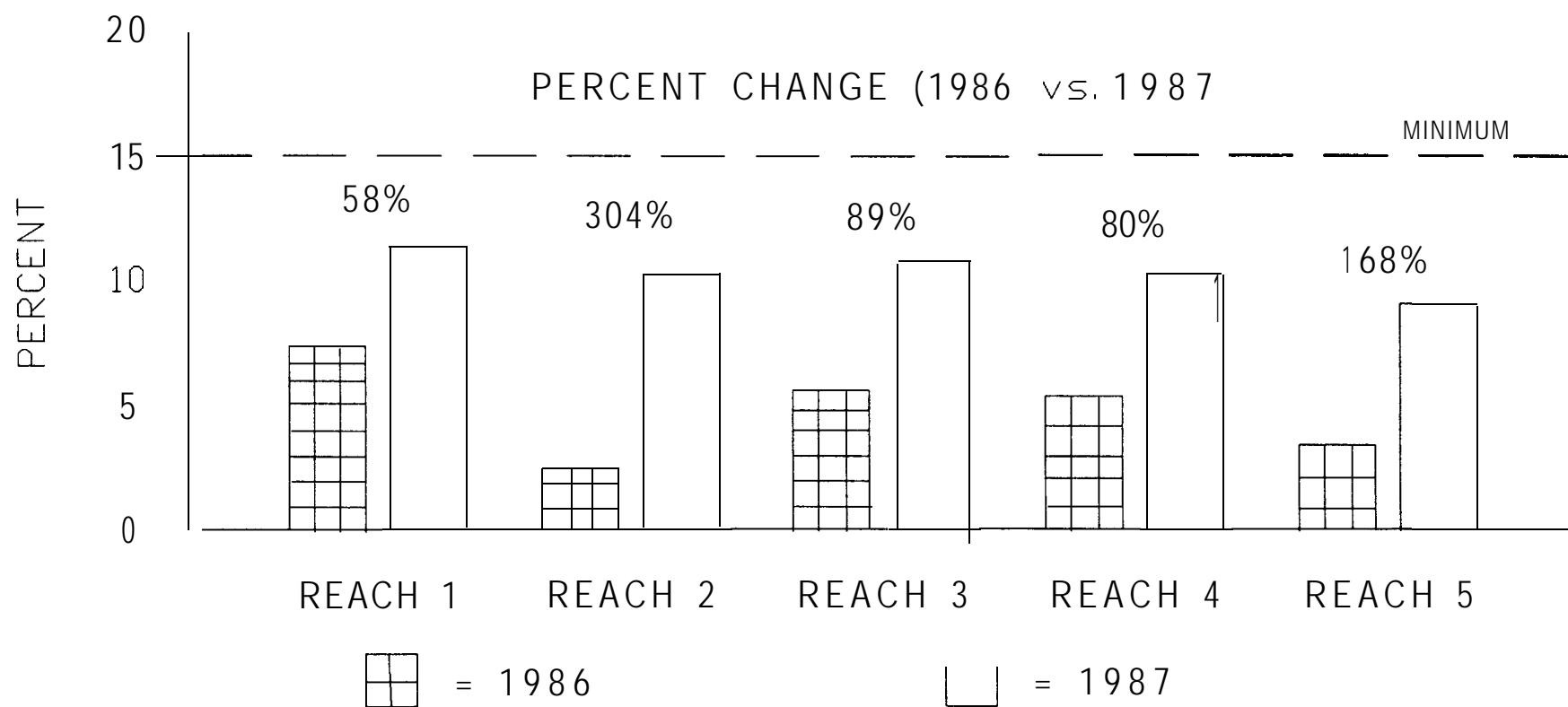
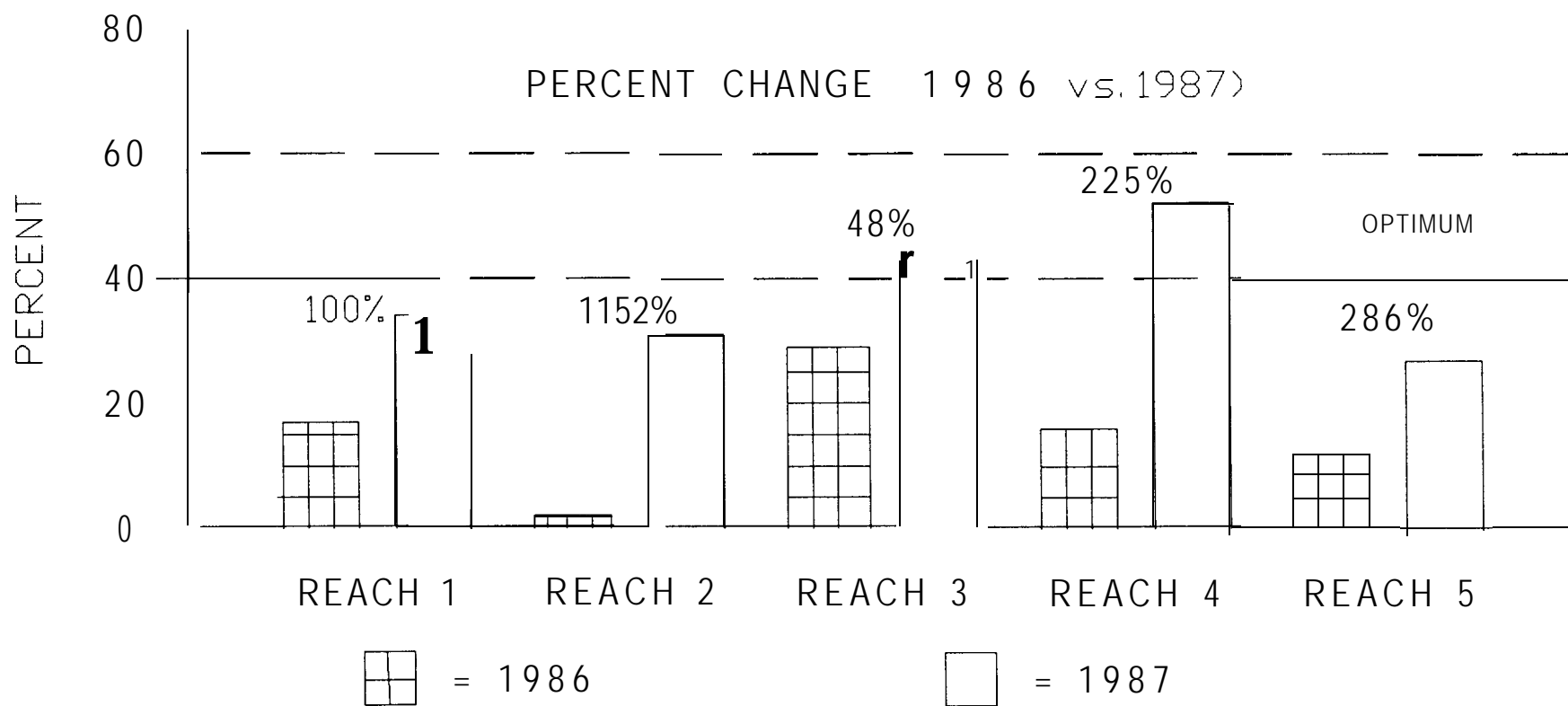


FIGURE 47: POOL AREA (PERCENT OF TOTAL SURFACE AREA)



# **SOUTH FORK JOHN DAY RIVER HABITAT ENHANCEMENT PROJECT**

## **FINAL REPORT**

Prepared by:

Ron Wiley, Fisheries Biologist  
Bureau of Land Management  
Burns, OR

Prepared for:

U.S. Department of Energy  
Bonneville Power Administration  
Division of Fish and Wildlife  
P.O. Box 3621  
Portland, OR 97283-3621

Project Number 85-71  
Contract Number DE-AI79-85BP25385

MAY 1993

TITLE: Project 85-71 - SOUTH FORK JOHN DAY RIVER HABITAT ENHANCEMENT PROJECT

FINAL REPORT - (Construction Phase)

AGREEMENT No.: DE-AI79-85BP25385

PROJECT PERIOD: September 1, 1985 to March 31, 1987

EXECUTIVE SUMMARY: Rearing area was increased in the South Fork John Day River through the **instream** placement of 1,500 boulders.

ABSTRACT: During September 1986, 1,500 boulders were placed in 14 reaches of the South Fork John Day River approximately between RM 14 and RM 25. Each boulder was **3-feet** or greater in at least one dimension. A number of smaller boulders were also placed by the contractor rather than return them to the rock pit. The boulders were placed in a variety of configurations, each determined as best fitted to specific site features (i.e., depth, flow, velocity, bank condition, existing or potential riparian cover, etc.). **It** is estimated that after fully developed this project will provide rearing area for an additional 7,500 summer steelhead smolts.

Introduction:

The South Fork John Day River (SFJDR) contains important wild summer steelhead habitat. About 1,000 adult fish (est. 1,200; 1985) valued at \$359,000 (Meyers, 1982) annually return to the drainage to spawn. All tributaries accessible to steelhead are used for spawning. Additionally, juvenile steelhead rear in the SFJDR and its tributaries from two to three years before migrating to the ocean.

The role of the SFJDR in rearing juvenile steelhead, particularly from age **1+** to smolt, is vital to the system as a whole. Many, if not all, of the tributaries produce juveniles in numbers exceeding the stream's capacity to rear to smolt. These fish migrate to the SFJDR and are reared to smolt there.

Factors limiting steelhead production in the SFJDR are: 1) poor quantity and quality of pool habitat; 2) low summer flows; 3) high water temperatures; and 4) excessive sediment load. This project exhausts available opportunities to structurally improve pool habitat on BLM-administered reaches below Izee Falls. In excess of \$300,000 has now been expended in this direction. These monies have come from the BLM, **ODF&W** and with this project, the BPA. The second, third and fourth factors are the direct result of inadequate riparian systems and watershed management problems in headwater areas. The riparian systems along the SFJDR on BLM and ODF&W-administered lands are improving through improved management and are expected to eventually recover. As a result, water temperatures have dropped and there has been some reduction in sediment load. While data documenting this is lacking it can be extrapolated from the decrease in eroding streambanks and greatly increased shading along the river reach in question. It could also be reasonably expected that some increase in late summer flows has occurred. Emphasis in this direction is continuing and additional improvements are anticipated.

A stream survey conducted by the Burns District Fisheries Biologist in 1981 revealed several stream reaches which were deficient in **instream** cover, particularly pool area. This project was designed to provide this needed cover.

#### Project Description:

The project area is Located in southeastern Grant County in the Burns District, Bureau of Land Management, in T. 14 S., R. 26 E.; T. 15 S., R. 26 E.; and T. 16 S., R. 26 E.; T. 16 S., R. 27 E., W.M. The South Fork John Day River is a tributary to the mainstream John Day River and has its mouth at Dayville, Oregon.

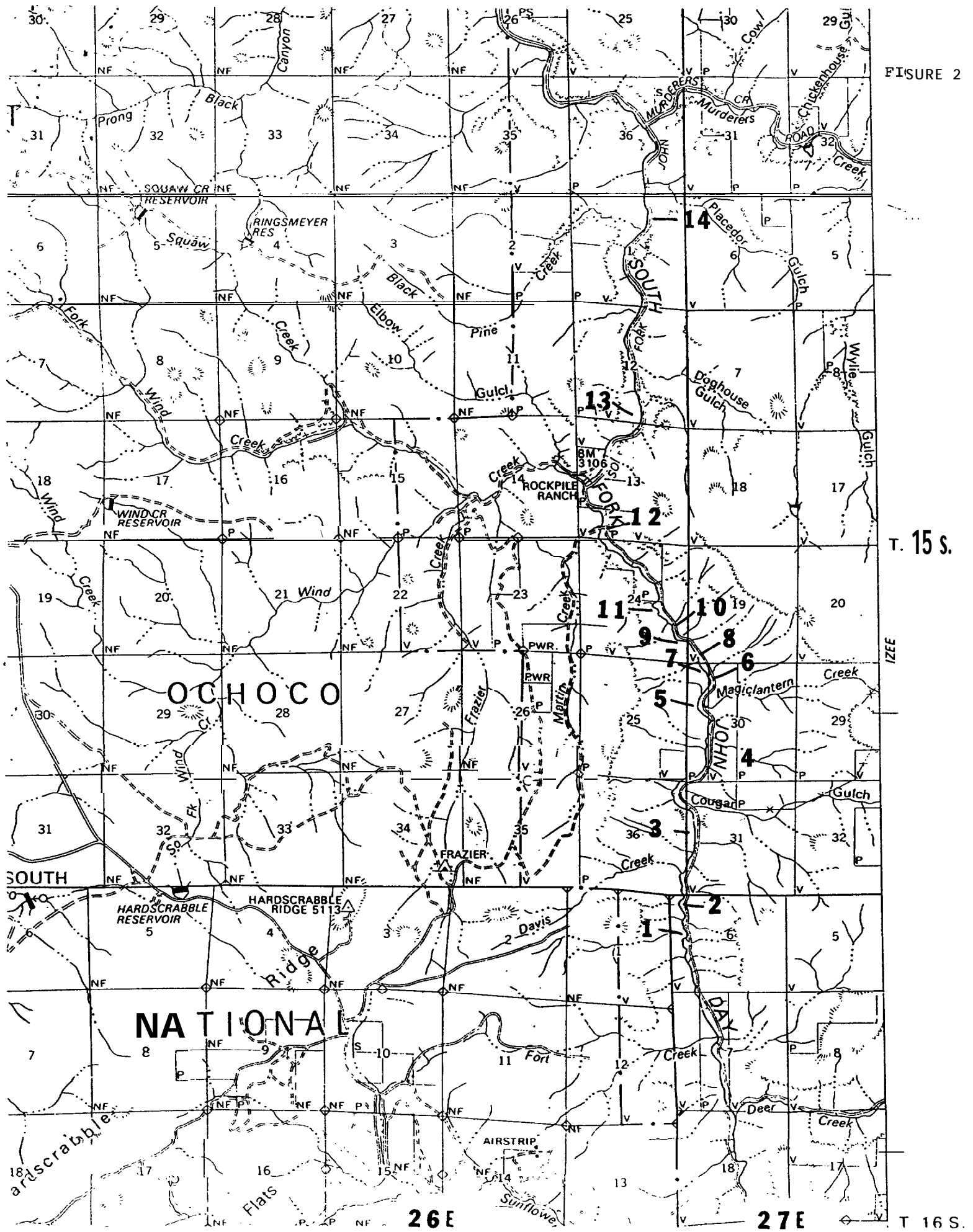
Project activities consisted of preparing and administering contracts for the development of a rock pit to provide necessary boulders and placing 1,500 boulders in 14 reaches of SFJDR approximately between RM 14 and RM 25 (Figures 1 and 2).

The blasting contractor worked between July 14 and 15. He attempted to shoot the pit in such a manner so as to produce 1,500 **3+** foot diameter boulders. Due to undetected fractures in the rock, the shoot produced only about 500 boulders of the desired dimensions. The remainder was obtained from the Izee County pit and along the South Fork road. Boulders obtained from the Izee County pit were Loaded and delivered on site by BLM equipment and employees. These boulders were somewhat Larger than those obtained from either the pit or from along the road. Approximately 100 boulders were obtained from this source.

The boulder placement contractor worked between September 3 and 20. He used a  $\frac{3}{4}$  yard rubber-tired backhoe to place the boulders in the river. A 1-yard crawler excavator was used to work the pit. A total of 1,500 acceptable boulders were placed in the river at specific locations staked by the project inspector. A number of undersize boulders were also placed in the river rather than return them to the pit. These undersize boulders were placed in tight groups in an attempt to get some utility from them. The useful life of these will likely be short, but as they were in fact placed free of charge and will pose no future problems, this was considered to be an excellent method of disposing of them.

The boulders were placed in various configurations including V's (both upstream and downstream), diamonds, double V's, lines perpendicular to the flow, jetty-like groups, as well as relatively random distribution in existing pools otherwise devoid of cover. The particular configuration chosen for a specific site was determined after careful examination and consideration of site conditions including flow, velocity, depth, substrate, channel morphology, existing **instream** objects, bank condition and riparian cover. In addition to increased stream cover, it is anticipated that some bank stabilization and subsequent stream bank revegetation will occur as a result of this project. It is estimated that a minimum of 1,000 square yards of new pool area will be created by the boulders placed in this project.

FIGURE 2



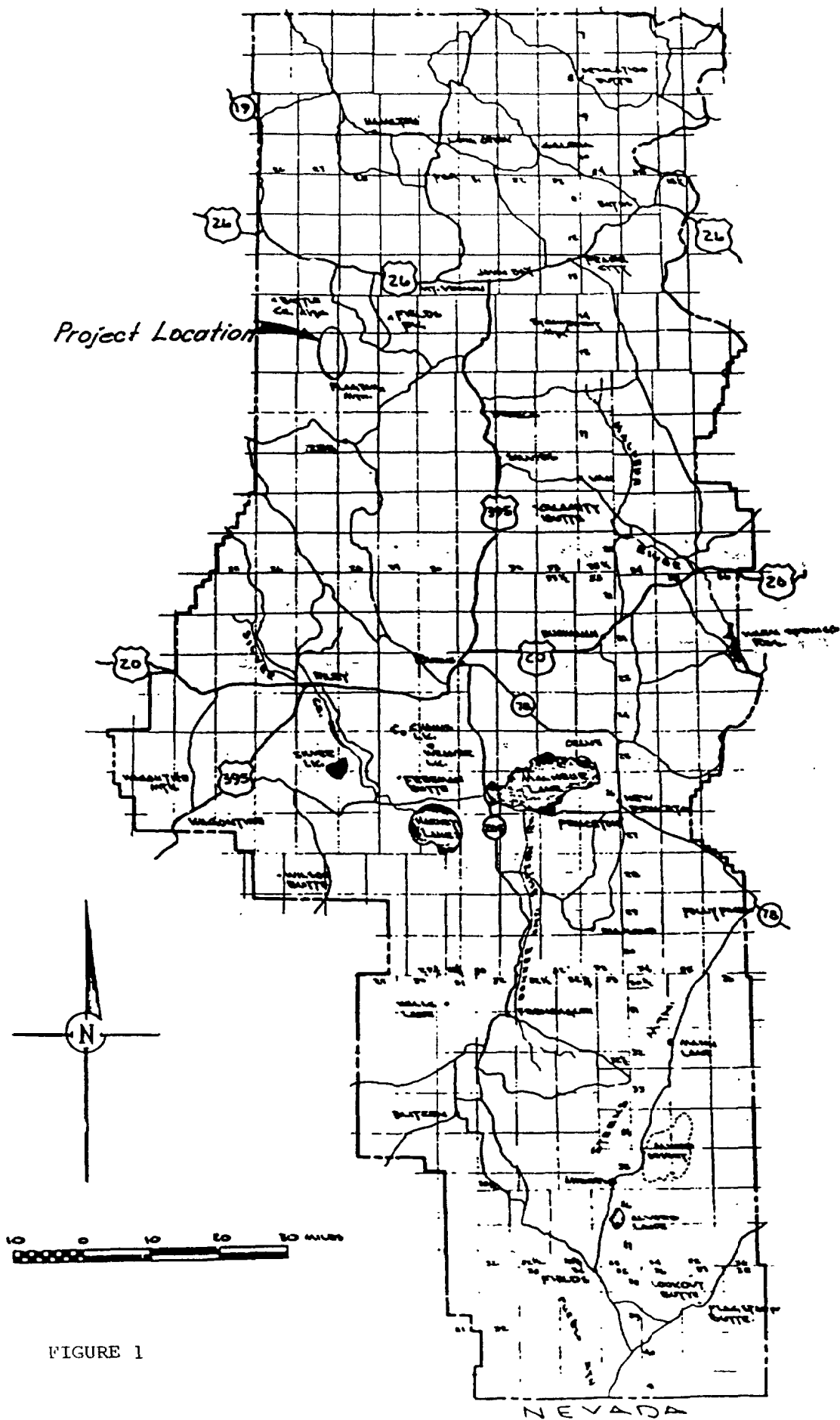


FIGURE 1



Table I

## Estimated Smolt Production Increase

Before South Fork Project

Miles of stream in project area	10.5
Number of smolts per mile (est.)	1,400
<b>Smolt</b> production before	<u>14,700</u>

After South Fork Project

Actual miles of stream treated in project area	3.0
Number of smolts per mile (est.)	1,400
<b>Smolt</b> production before	<u>4,200</u>
Percent of increase first year after project	119
<b>Smolt</b> production after	<u>9,200</u>
Smolt production before (actual treated miles)	<u>4,200</u>
Increased smolt production first year <u>1/</u>	<u>5,000</u>

or

Boulders placed	1,500
Fish per boulder (after fully developed)	5
Smolt production after <u>2</u>	<u>7,500</u>
Increased smolt production <u>3/</u>	7,500
Five percent spawning escapement	x .05
Adult spawners	<u>375</u>
Net value per escaping summer steelhead <u>4/</u>	\$ 359
Estimated annual value of boulder placement	<u>\$134,625</u>

1/ Using ODF&W data (Lindsay, 1983)2/ Using BLM unpublished data3/ Assumption is used that after 3 to 5 years both production figures would equalize at the higher value.4/ Meyers, 1982

## Results and Conclusions:

It is expected that 2 to 3 years will be required to achieve full development of the project. Water scour is being relied upon to form pools. This approach is Less immediate but considerably less expensive than constructed pools. Also the short-term impact to water quality is reduced using this approach. Immediate benefits will be realized through increased refugia from high velocities during the spring runoff.

When fully developed and stabilized it is estimated that rearing area for an additional 7,500 smolts will be provided with this project (Table 1).

Previous **electroshocking** studies (BLM, unpublished data), of earlier boulder placements in the SFJDR revealed that an average of 5 rainbow-steelhead **smolts** use each boulder. This is expected to hold true for this project as well. A habitat evaluation study carried out by **ODF&W** in 1983 (Lindsay, 1983) on Deer Creek, a tributary of the SFJDR, showed a 119 percent increase in age 1 and older rainbow-steelhead 1-year after boulder placement. If the assumption is used that this \*will hold true in the SFJDR, it could be expected that 5,000 additional age 1 and older rainbow-steelhead will use the treated reaches the first year post-project. With full pool development this figure would rise over the next 3 to 5 years. As can be seen from the above discussion, the figure of 7,500 additional smolts can be expected to be reasonably accurate.

Using this figure as the expected increased production of summer steelhead **smolts**, an increase in annual adult production of 1,125 adult fish could be expected with 375 of these returning spawners and 750 harvested.

These fish would have an estimated net value of \$134,625 using National Marine Fisheries Service economic values (Meyers, 1982).

## REFERENCES

- Lindsay, R.B., et.al., 1983. "John Day River Habitat Enhancement Evaluation, Annual Report, **1983**", In: Natural Propagations and Habitat Improvement, Volume I, Oregon, Funded by Bonneville Power **Administration** Agreement No. **DE-A179-83BP39801**, Project No. 82-9, April 1984.
- Meyers, Philip A., 1982. "Net Economic Values for Salmon and Steelhead from the Columbia River System", USDC, National Marine Fisheries Services, 26 pages, June 1982.
-